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(54) MACHINERY FOR AUTOMATED MANUFACTURE OF INNERSPRING ASSEMBLIES

ANLAGE ZUR AUTOMATISIERTEN HERSTELLUNG VON FEDERKERNEN

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Description

Field of the Invention

[0001] The present invention pertains to a system, an assembler and a machine, as per the preambles of claims 1, 7 and 20 for automated assembly of innerspring assemblies having an array of interconnected wire springs or coils. An example is known from US-A-4413659.

Background of the Invention

[0002] Innerspring assemblies, for mattresses, furniture, seating and other resilient structures, were first assembled by hand by arranging coils or springs in a matrix and interconnecting them with lacing or tying wires. The coils are connected at various points along the axial length, according to the innerspring design. Machines which automatically form coils have been mated with various conveyances which deliver coils to an assembly point. For example, U.S. Patent Nos. 3,386,561 and 4,413,659 describe apparatus which feeds springs from an automated spring former to a spring core assembly machine. The spring or coil former component is configured to produce a particular coil design. Most coil designs terminate at each end with one or more turns in a single plane. This simplifies automated handling of the coils, such as conveyance to an assembler and passage through the assembler. The coil forming machinery is not easily adapted to produce coils of alternate configurations, such as coils which do not terminate in a single plane.

[0003] The timed conveyance of coils from the former to the assembler is always problematic. Automated production is interrupted if even a single coil is misaligned in the conveyor. The conveyor drive mechanism must be perfectly timed with operation of the coil former and a transfer machine which picks up an entire row of coils from a conveyor and loads it into the innerspring assembler.

[0004] The spring core assembly component of the prior art machines is typically set up to accommodate one particular type of spring or coil. The coils are held within the machine with the base or top of the coil fit over dies or held by clamping jaws, and tied or laced together by a helical wire or fastening rings. This approach is limited to use with coils of particular configurations which fit over the dies and within the helical lacing and knuckling shoes. Such machines are not adaptable to use with different coil designs, particularly coils with a terminal convolution which extends beyond a base or end of the coil. Also, these types of machines are prone to malfunction due to the fact that two sets of clamping jaws, having multiple small parts and linkages moving at a rapid pace, are required for the top and bottom of each coil.

Summary of the Invention

[0005] The present invention overcomes these and other disadvantages of the prior art by providing novel machinery for complete automated manufacture of formed wire innerspring assemblies from wire stock. In accordance with the invention, there is provided an automated innerspring assembly system according to claim 1.

5 **[0006]** In a system for automated manufacture of innerspring there may be provided assemblies having a plurality of generally helical coils interconnected in a matrix array, the system having a coil formation device operative to produce individual coils for an innerspring assembly, the coil formation device having a pair of rollers for drawing wire stock into a coil forming block, a cam driven forming wheel which imparts a generally helical shape to the wire stock fed through the coil forming block, a guide pin which sets a pitch to the generally helical
10 shape of the coil, and a cutting device which cuts a formed coil from the wire stock, the coil forming block having a cavity in which a terminal convolution of a coil having a diameter less than a body of the coil fits during formation of the coil, and into which the cutting device extends to
15 cut the coil from the wire stock at an end of the terminal convolution, at least one coil head forming station having one or more punch dies for forming non-helical shapes in coils, the coil head forming station having a jig which accommodates a terminal convolution of a coil which extends beyond a portion of the coil to be formed in a non-helical shape by the coil head forming station, a tempering device which passes an electrical current through a coil, and a geneva having a plurality of arms, each arm having a gripper operative to grip a coil from the coil forming
20 block, advance the coil to a coil head forming station and to the tempering device, and from the tempering device to a coil conveyor; a coil conveyor operative to convey coils from the coil formation device to a coil transfer machine, the coil conveyor having a plurality of flights
25 slidably mounted upon a track which extends along upper and lower sides of the conveyor, each flight connected to a main chain mounted upon sprockets at each end of the coil conveyor, each flight having a clip configured to engage a coil, an indexer flight drive mechanism operative
30 to advance the flights along the conveyor tracks, a coil orientation device operative to uniformly orient each of the coils in the flight clips, and a braking mechanism for retarding the advance of flights along the conveyor tracks; a coil transfer machine having a plurality of arms, each arm having a gripper operative to grip a coil and remove it from a flight clip of the conveyor, and present the gripped coil to an innerspring assembler, the coil transfer movably mounted proximate to the conveyor and to the innerspring assembler; an innerspring assembler
35 operative to interconnect rows of coils presented by the coil transfer machine, the innerspring assembler having two sets of upper and lower coil-engaging dies mounted upon carrier bars, whereby rows of coils can be inserted
40 into the innerspring assembler.

45 **[0007]** The present invention overcomes these and other disadvantages of the prior art by providing novel machinery for complete automated manufacture of formed wire innerspring assemblies from wire stock. In accordance with the invention, there is provided an automated innerspring assembly system according to claim 1.

50 **[0008]** In a system for automated manufacture of innerspring there may be provided assemblies having a plurality of generally helical coils interconnected in a matrix array, the system having a coil formation device operative to produce individual coils for an innerspring assembly, the coil formation device having a pair of rollers for drawing wire stock into a coil forming block, a cam driven forming wheel which imparts a generally helical shape to the wire stock fed through the coil forming block, a guide pin which sets a pitch to the generally helical
55 shape of the coil, and a cutting device which cuts a formed coil from the wire stock, the coil forming block having a cavity in which a terminal convolution of a coil having a diameter less than a body of the coil fits during formation of the coil, and into which the cutting device extends to
60 cut the coil from the wire stock at an end of the terminal convolution, at least one coil head forming station having one or more punch dies for forming non-helical shapes in coils, the coil head forming station having a jig which accommodates a terminal convolution of a coil which extends beyond a portion of the coil to be formed in a non-helical shape by the coil head forming station, a tempering device which passes an electrical current through a coil, and a geneva having a plurality of arms, each arm having a gripper operative to grip a coil from the coil forming
65 block, advance the coil to a coil head forming station and to the tempering device, and from the tempering device to a coil conveyor; a coil conveyor operative to convey coils from the coil formation device to a coil transfer machine, the coil conveyor having a plurality of flights
70 slidably mounted upon a track which extends along upper and lower sides of the conveyor, each flight connected to a main chain mounted upon sprockets at each end of the coil conveyor, each flight having a clip configured to engage a coil, an indexer flight drive mechanism operative
75 to advance the flights along the conveyor tracks, a coil orientation device operative to uniformly orient each of the coils in the flight clips, and a braking mechanism for retarding the advance of flights along the conveyor tracks; a coil transfer machine having a plurality of arms, each arm having a gripper operative to grip a coil and remove it from a flight clip of the conveyor, and present the gripped coil to an innerspring assembler, the coil transfer movably mounted proximate to the conveyor and to the innerspring assembler; an innerspring assembler
80 operative to interconnect rows of coils presented by the coil transfer machine, the innerspring assembler having two sets of upper and lower coil-engaging dies mounted upon carrier bars, whereby rows of coils can be inserted
85 into the innerspring assembler.

into the innerspring assembler between upper and lower coil-engaging dies by the coil transfer machine, the innerspring assembler further comprising an elevator assembly operative to vertically translate the carrier bars toward and away from terminal ends of coils in the innerspring assembler, and an indexer assembly operative to horizontally translate the carrier bars, whereby the two sets of upper and lower coil-engaging dies and corresponding carrier bars can converge and retract relative to rows of coils in the innerspring assembler, and can laterally exchange positions to advance rows of coils out of the innerspring assembler, the innerspring assembler further comprising a lacing wire feeder operative to feed a lacing wire through an opening formed by adjacent coil-engaging dies and about portions of coils engaged in the dies to thereby interconnect rows of coils.

[0007] The invention is herein described in particularized detail with reference to the accompanying Figures.

Brief Description of the Figures

[0008] In the accompanying Figures:

FIG. 1 is a plan view of the machinery for automated manufacture of formed wire innerspring assemblies of the present invention;

FIG. 2 is an elevational view of a coil former machine; FIG. 3A is a perspective view of a conveyance device;

FIG. 3B is a perspective view of the conveyance device of FIG. 3A;

FIG. 3C is a cross-sectional side view of the conveyance device of FIG. 3A;

FIG. 3D is a sectional view of the conveyance device of FIG. 3D;

FIG. 3E is a sectional view of the conveyance device of FIG. 3E;

FIG. 4A is a side elevation of a coil transfer machine used in connection with the machinery for automated manufacture of formed wire innerspring assemblies of the present invention;

FIG. 4B is an end elevation of the coil transfer machine of FIG. 4A;

FIG. 5 is a perspective view of an innerspring assembly machine of the present invention;

FIG. 6A is an end view of the innerspring assembly machine of FIG. 5;

FIG. 6B is a perspective view of a knuckler die attachable to the innerspring assembler;

FIGS. 7A-7I are schematic diagrams of coils, coil-receiving dies, and die support pieces as arranged and moved within the innerspring assembly machine of FIG. 5;

FIGS. 8A and 8B are cross-sectional and top views of a coil-engaging die of the present invention;

FIGS. 9A and 9B are end views of the innerspring assembly machine of FIG. 5;

FIG. 10A is an end view of the innerspring assembly

machine of FIG. 5;

FIG. 10B is an isolated perspective view of an indexing subassembly of the innerspring assembly machine of FIG. 5;

FIG. 11 is an isolated elevational view of a clamp subassembly of the innerspring assembly machine of FIG. 5;

FIG. 12 is a partial plan view of an innerspring assembly producible by the machinery of the present invention;

FIG. 13 is a partial elevational view of the innerspring assembly of FIG. 11;

FIG. 14A is a profile view of a coil of the innerspring assembly of FIG. 11;

FIG. 14B is an end view of a coil of the innerspring assembly of FIG. 11;

FIGS. 15A-15D are cross-sectional views of a belt-type coil conveyance system of the present invention;

FIG. 16 is a top view of a chain winder version of a coil conveyance system of the present invention;

FIGS. 17A-17G are elevational views of an alternate coil connecting mechanism of the present invention;

FIGS. 18A-18G are elevational views of an alternate coil connecting mechanism of the present invention, and

FIGS. 19A-19F are elevational views of an alternate coil connecting mechanism of the present invention.

Detailed Description of Preferred and Alternate Embodiments

[0009] The described machinery and methods can be employed to produce innerspring assemblies 1, including mattress or furniture or seating innerspring assemblies, in a general form as depicted in FIGS. 12 and 13. The innerspring assembly 1 includes a plurality of springs or coils 2 in an array such as an orthogonal array, with axes of the coils generally parallel and ends 3 of the coils generally coplanar, defining resilient support surfaces of the innerspring assembly 1. The coils 2 are "laced" or wire-bound together in the array by, for example, generally helical lacing wires 4 which run between rows of the coils and which wrap or lace around tangential or overlapping segments of adjacent coils as shown in FIG. 13. Other means of coil fastening can be employed within the scope of the invention.

[0010] The coils formed by the coil formation components of the machinery may be of any configuration or shape formable from steel wire stock. Typically, innerspring coils have an elongated coil body with a generally helical configuration, terminating at the ends with a planar wire form which serves as a base or head of the coil to which loads are applied. Other coil forms and innerspring assemblies not expressly shown are nonetheless producible by the described machinery and are within the scope of the invention.

[0011] The following machinery and method descrip-

tions are made with reference to a particular mattress innerspring with a particular type of coil 2 shown in isolation in FIGS. 14A and 14B. An example of this type of coil is described and claimed in U.S. Patent No. 5,013,088. The coil 2 has a generally helical elongate coil body 21 which terminates at each end with a head 22. Each head 22 includes a first offset 23, second offset 24, and third offset 25. A generally helical terminal convolution 26 extends from the third offset 25 axially beyond the head. A force responsive gradient arm 27 may be formed in a segment of the helical body 21 leading or transitioning to the coil head 22.

[0012] As shown in FIG. 14B, the first offset 23 may include a crown 28 which positions the offset a slightly greater distance laterally from the longitudinal axis of the coil. The second and third offsets 24 and 25 are also outwardly offset from the longitudinal axis of the coil. As shown in Figure 13, the first and third offsets 23 and 25 of each coil overlap the offsets of adjacent coils and are laced together by the helical lacing wires 4, and the terminal convolutions 26 extend beyond (above and below) the points of laced attachment of the coil head offsets.

[0013] FIG. 1 illustrates the main components of the automated innerspring manufacturing system 100 of the invention. Coil wire stock 110 is fed from a spool 200 to one or more coil former machines 201, 202 which produce coils such as shown in FIGS. 14A, 14B or any other types of generally helical coils or other discrete wire form structures. The coils 2 are loaded into one or more coil conveyors 301, 302 which convey coils to a coil transfer machine 400. The coil transfer machine 400 loads a plurality of coils into an innerspring assembly machine 500 which automatically assembles coils into the described innerspring array by attachment with, for example, a helical formed lacing wire stock 510 spool-fed to the assembler through a helical wire former and feeder 511, also referred to as a coil interconnection device.

[0014] Each of the main components of the system 100 are now described individually, followed by a description of the system operation and the resulting wire form structure innerspring assembly. Although described with specific reference to the automated formation and assembly of a particular innerspring, it will be appreciated that the various components of the invention can be employed to produce any type of wire form structure.

Coil Formation

[0015] The coil formers 201, 202 may be, for example, a known wire formation machine or coiler, such as a Spuhi LFK coiler manufactured by Spuhi AG of St. Gallen, Switzerland. As shown schematically in FIG. 2, the coil formers 201, 202 feed wire stock 110 through a series of rollers to bend the wire in a generally helical configuration to form individual coils. The radius of curvature in the coils is determined by the shapes of cams (not shown) in rolling contact with a cam follower arm 204. The coil wire stock 110 is fed to the coiler by feed rollers 206 into

a forming block 208. As the wire is advanced through a guide hole in the forming block 208, it contacts a coil radius forming wheel 210 attached to an end of the cam follower arm 204. The forming wheel 210 is moved relative to the forming block 208 according to the shapes of the cams which the arm 204 follows. In this manner, the radius of curvature of the wire stock is set as the wire emerges from the forming block.

[0016] A helix is formed in the wire stock after it passes the forming wheel 210 by a helix guide pin 214 which moves in a generally linear path, generally perpendicular to the wire stock guide hole in the forming block 208, in order to advance the wire in a helical path away from the forming wheel 210.

[0017] Once a sufficient amount of wire has been fed through the forming block 208, past the forming wheel 210 and the helix guide pin 214, to form a complete coil, a cutting tool 212 is advanced against the forming block 208 to sever the coil from the wire stock. The severed coil is then advanced by a geneva 220 to subsequent formation and processing stations as further described below.

[0018] As shown in FIG. 14B, the coil 2 has several different radii of curvature in the helical coil body. In particular, the radius or total diameter of the terminal convolution 26 is significantly less than that of the main coil body 21. Furthermore, the wire terminates and must be severed at the very end of the terminal convolution 26. This particular coil structure presents a problem with respect to the forming block 208 which must be specifically configured to accommodate the terminal convolution 26, allow the larger diameter coil body to advance over the forming block, and allow the cutting tool 212 to cut the wire at the very end of the terminal convolution.

[0019] Accordingly, as shown in FIG. 2, the forming block 208 includes a cavity 218 dimensioned to receive a terminal convolution of the coil. The cutting tool 212 is located proximate to the cavity 218 in the forming block 208 to sever the wire at the terminal convolution.

[0020] A geneva 220 with, for example, six geneva arms 222, is rotationally mounted proximate to the front of the coiler. Each geneva arm 222 supports a gripper 224 operative to grip a coil as it is cut from the continuous wire feed at the guide block 208. The geneva rotationally indexes to advance each coil from the coiler guide block to a first coil head forming station 230. Pneumatically operated punch die forming tools 232 are mounted in an annular arrangement about the first coil head forming station 230 to form the coil offsets 23-25, the force responsive gradient arm 27, or any other contours or bends in the coil head at one end of the coil body. The geneva then advances the coil to a second coil head forming station 240 which similarly forms a coil head by punch dies 232 at an opposite end of the coil. The geneva then advances the coil to a tempering station 250 where an electrical current is passed through the coil to temper the steel wire. The next advancement of the geneva inserts the coil into a conveyor, 301 or 302, which carries the

coils to a coil transfer machine as further described below. As shown in FIG. 1, one or more coil formation machines may be used simultaneously to supply coils in the innerspring assembly system.

Coil Conveyance

[0021] As shown in FIG. 1, coils 2 are conveyed in single file fashion from each of the coil formation machines 201, 202 by respective similarly constructed coil conveyors 301, 302 to a coil transfer machine 400. Although described as coil conveyors in the context of an inner-spring manufacturing system, it will be appreciated that the conveyance systems of the invention are readily adaptable and applicable to any type of system or installation wherein conveyance of any type of object or objects is required. As further shown in FIGS. 3A-3E, conveyor 301 includes a box beam 303 which extends from the geneva 220 to a coil transfer machine 400. Each beam 303 includes upper and lower tracks 304 formed by opposed rails 306, mounted upon side walls 307. A plurality of flights 308 are slidably mounted between rails 306. Each flight 308 has a clip 310 configured to engage a portion of a coil, such as two or more turns of the helical body of a coil, as it is loaded by the geneva 220 to the conveyor. As further shown in FIGS. 3C and 3E, each flight 308 has a body 309 with opposed parallel flanges 311 which overlap and slide between rails 306. A bracket 312 depends from the body 309 of each flight. Each bracket is attached to a pair of adjacent pins 313 of links 314 of a main chain 315, with additional link 314 between each of the flights. The main chain 315 extends the length of the beam 302 and is mounted on sprockets 316 at each end of each beam. The flights 308 are thus evenly spaced along the main chain 315.

[0022] To translate the flights 308 in an evenly spaced progression along track 304, an indexer 320 is mounted within the box beam 303. The index 320 includes two parallel indexer chains 321 which straddle the main chain 315 and ride on co-axial pairs of sprockets 322. The sprockets 322 are mounted upon shafts 324. The chains 321 carry attachments 323 at an equidistant spacing, equal to the spacing of the flights 308 when the main chain 315 is taut. Once the main chain is no longer driven by the indexer, the main chain goes slack and the flights begin to stack against one another, as shown at the right side of FIGS. 3A and 3B. Now the pitch between flights is no longer determined by the distance between attachments on the main chain, but by the length of the flight bodies 309 which abut. This allows the conveyor to be loaded at one pitch, and unloaded at a different pitch.

[0023] The conveyor is further provided with a brake mechanism. As shown in FIG. 3D, a brake mechanism includes a linear actuator 331 with a head 332 driven by an air cylinder 330 or equivalent means to apply a lateral force to a flight positioned next to the actuator, thus pinching the flight against the interior side of the track 304. By controlling the air pressure in the air cylinder 330, the

degree and timing of the resulting braking action of flights along the conveyor can be selectively controlled.

[0024] Alternatively, as shown in FIG. 3E, a fixed rate spring 334 may be incorporated into the horizontal flange

5 of a track 304 where it is passed by each flight and applies a constant braking force to each of the flights. The size or rate of the spring can be selected depending upon the amount of drag desired at the brake point along the conveyor track.

[0025] Associated with each coil conveyor is a coil straightener, shown generally at 340 in FIGS. 3A and 3B. The coil straightener 340 operates to uniformly orient each coil within a flight clip 310 for proper interface with coil transfer machinery described below. Each straightener 340 includes a pneumatic cylinder 342 mounted adjacent beam 303. An end effector 344 is mounted upon a distal end of a rod 346 extending from the cylinder 342. The pneumatic cylinder is operative to impart both linear and rotary motion to the rod 346 and end effector 344.

10 In operation, as a coil is located in front of the straightener 340 during passage of a flight, the end effector 344 translates out linearly to engage the presented end of the coil and simultaneously or subsequently rotates the coil within the flight clip to a uniform, predetermined position. The

15 helical form of the coil body engaged in the flight clip allows the coil to be easily turned or "screwed" in the clip 310 by the straightener. Each coil in the conveyors is thereby uniformly positioned within the flight clips downstream of the straightener.

[0026] The described coil conveyance can also be accomplished by certain alternative mechanisms which are also a part of the invention. As shown in FIGS. 15A-15D, an alternate device for conveying coils from a coil former to a coil transfer station is a belt system, indicated generally at 350, which includes a pocketed flap belt 352 and an opposing belt 354. Coils 2 are positioned by a geneva to extend axially between the belts 352 and 354, as shown in FIG. 15A. The flap belt 352 has a primary belt 353 and a flap 355 attached to the primary belt 353 along a bottom edge. As shown in FIG. 15B, a fixed opening wedge 356 spreads the flap 355 away from the primary belt 353 to facilitate insertion of the coil head into the pocket formed by the flap and primary belt. An automated insertion tool may be used to urge the coil heads into the

20 pocket. As shown in FIG. 15C, a straightening arm 358 is configured to engage a portion of the coil head, and driven to uniformly orient the coils within the pocket. Once inserted into the pocket and correctly oriented, the coils are held in position relative to the belts by a compressing bar 360 against which the exterior surface of flap 355 bears. The compressing bar 360 is movable at the region where the coils are removed from the belt by a coil transfer machine, to release the pressure on the flap to allow removal of the coils from the pocket. As further shown,

25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100 105 110 115 120 125 130 135 140 145 150 155 160 165 170 175 180 185 190 195 200 205 210 215 220 225 230 235 240 245 250 255 260 265 270 275 280 285 290 295 300 305 310 315 320 325 330 335 340 345 350 355 360 365 370 375 380 385 390 395 400 405 410 415 420 425 430 435 440 445 450 455 460 465 470 475 480 485 490 495 500 505 510 515 520 525 530 535 540 545 550 555 560 565 570 575 580 585 590 595 600 605 610 615 620 625 630 635 640 645 650 655 660 665 670 675 680 685 690 695 700 705 710 715 720 725 730 735 740 745 750 755 760 765 770 775 780 785 790 795 800 805 810 815 820 825 830 835 840 845 850 855 860 865 870 875 880 885 890 895 900 905 910 915 920 925 930 935 940 945 950 955 960 965 970 975 980 985 990 995 1000 1005 1010 1015 1020 1025 1030 1035 1040 1045 1050 1055 1060 1065 1070 1075 1080 1085 1090 1095 1100 1105 1110 1115 1120 1125 1130 1135 1140 1145 1150 1155 1160 1165 1170 1175 1180 1185 1190 1195 1200 1205 1210 1215 1220 1225 1230 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9235 9240 9245 9250 925

rigidity to securely hold the coils between them, and sufficient flexibility to be mounted upon and driven by pulleys, and to make turns in the conveyance path.

[0027] FIG. 16 illustrates pairs of spring winders 360 which can be employed as alternate coil conveyance mechanisms in connection with the system of the invention. Each spring winder 360 includes a primary chain 361 and secondary chain 362 driven by sprockets 364 to advance at a common speed from a respective coil former to a coil transfer station or assembler as further described below. Coil engaging balls 366, dimensioned to fit securely within the terminal convolutions of the coils, are mounted at equal spacings along the length of each chain. The chains are timed to align the balls 366 in opposition for engagement of a coil presented by the ge-neva. Each chain may be selectively controlled to change the relative angle of the coils as they approach the coil transfer stage, as shown at the right side of FIG. 16. Magnets may be used in addition to or in place of balls 366 to hold the coils between the sets of chains.

Coil Transfer

[0028] As shown in FIGS. 1 and 4A and 4B, each conveyor 301, 302 positions a row of coils in alignment with a coil transfer machine 400. The coil transfer machine includes a frame 402 mounted on rollers 404 on tracks 406 to linearly translate toward and away from conveyors 301, 302 and the innerspring assembler 500. A linear array of arms 410 with grippers 412 grip an entire row of coils from the flights 304 of one of the conveyors and transfer the row of coils into the innerspring assembler. The number of operative arms 410 on the coil transfer machine is equal to a number of coils in a row of an innerspring to be produced by the assembler. By operation of a drive linkage schematically shown at 416, in combination with linear translation of the machine upon tracks 406. The coil transfer machine lifts an entire row of coils from one of the conveyors (at position A) and inserts them into an innerspring assembly machine 500. Such a machine is described in U.S. Patent No. 4,413,659, the disclosure of which is incorporated herein by reference. The innerspring assembler 500 engages the row of coils presented by the transferor as described below. The coil transfer machine 400 then picks up another row of coils from the other parallel conveyor (301 or 302) and inserts them into the innerspring assembly machine for engagement and attachment to the previously inserted row of coils. After the coils are removed from both of the conveyors, the conveyors advance to supply additional coils for transfer by the coil transfer machine into the innerspring assembler.

Innerspring Assembler

[0029] The primary functions of the innerspring assembler 500 are to:

- (1) grip and position at least two adjacent parallel rows of coils in a parallel arrangement;
- (2) connect the parallel rows of coils together by attachment of fastening means, such as a helical lacing wire to adjacent coils; and
- (3) advance the attached rows of coils to allow introduction of an additional row of coils to be attached to the previously attached rows of coils, and repeat the process until a sufficient number of coils have been attached to form a complete innerspring assembly.

[0030] As shown in FIGS. 5, 6, 9-10, the innerspring assembler 500 is mounted upon a stand 502 of a height appropriate to interface with the coil transfer machine 400. The innerspring assembler 500 includes two upper and lower parallel rows of coil-receiving dies, 504A and 504B which receive and hold the terminal ends of each of the coils, with the axes of the coils in a vertical position, to enable insertion or lacing of fastening means such as a helical wire between the coils, and to advance attached rows of coils out of the innerspring assembler. The dies 504 are attached side-by-side upon parallel upper and lower carrier bars 506A, 506B which are vertically and horizontally (laterally) translatable within the assembler. The innerspring assembler operates to move the carrier bars 506 with the attached dies 504 to clamp down on two adjacent rows of coils, fasten or lace the coils together to form an innerspring assembly, and advance attached rows of coils out of the assembler to receive and attach a subsequent row of coils. More specifically, the innerspring assembler operates in the following basic sequence, described with reference to FIGS. 7A-7I:

- 35 1) a first upper and lower pair of carrier bars 506A (with the attached dies 504A) are vertically retracted to allow for introduction of a row of coils from the coil transfer machine (FIG. 7A);
- 40 2) the first upper and lower pair of carrier bars 506A are vertically converged upon a newly inserted row of coils (FIG. 7C);
- 45 3) adjacent rows of coils clamped between the upper and lower dies 504 are attached by fastening or lacing through aligned openings in the adjacent dies (FIG. 7D);
- 50 4) the second upper and lower pair of carrier bars 506B are vertically retracted to release a preceding row of coils from the dies (FIG. 7E),
- 55 5) the upper and lower carrier bars 506A are laterally translated to the position previously occupied by upper and lower carrier bars 506B, to advance the attached rows of coils out of the assembler (FIG. 7I), and

6) carrier bars 506B are laterally translated opposite the direction of translation of carrier bars 506A, to swap positions with carrier bars 506A to position the dies to receive the next row of coils to be inserted (FIG. 7I).

[0031] In FIG. 7A coils are presented to the innerspring assembler by the coil transfer machine in the indicated direction. Upper and lower rows of dies 504A, mounted upon upper and lower carrier bars 506A, are vertically retracted to allow the entire uncompressed length of the coils to be inserted between the dies. A previously inserted row of coils is compressed between upper and lower dies 504B, mounted upon upper and lower carrier bars 506B positioned laterally adjacent to carrier bars 506A (FIG. 7B). The upper and lower dies 504A are converged upon the terminal ends of the newly presented coils to compress the coils to an extent equal to the preceding coils in dies 504B (FIG. 7C). The horizontally adjacent carrier bars 506A and 506B are held tightly together by back-up bars 550 (schematically represented in FIG. 7D), actuated by a clamping mechanism described below. With the dies clamped together, the adjacent rows of coils compressed between the upper and lower adjacent dies 504A and 504B are fastened together by insertion of a helical lacing wire 4 through aligned cavities 505 in the outer abutting side walls of the dies, and through which a portion of each coil in a die passes (FIG. 7E). The lacing wire 4 is crimped at several points to secure it in place upon the coils. When the attachment of two adjacent rows of coils within the dies is complete, clamps 550 are released (FIG. 7F) and the upper and lower dies 504B are vertically retracted (FIG. 7G). The upper and lower dies 504A and 504B are then laterally translated or indexed in the opposite directions indicated (in FIG. 7I) or swapped , to laterally exchange positions, whereby one row of attached coils are advanced out of the innerspring assembler, and the empty dies 504B are positioned for engagement with a newly introduced row of coils. The described cycle is then repeated with a sufficient number of rows of coils interconnected to form an innerspring assembly which emerges from the assembler onto a support table 501, as shown in FIGS. 1 and 5.

[0032] As shown in FIGS. 8A and 8B, the coil-engaging dies 504 are generally rectangular shaped blocks having tapered upward extending flanges 507 contoured to guide the head 22 of the coil 2 about the exterior of the die to rest upon a top surface 509 of side walls 511 of the die. As shown in FIG. 8A, two of the offsets of the coil head 22 extend beyond the side walls 511 of the die, next to an opening 505 through which the helical lacing wire 4 is guided to interconnect adjacent coils. A cavity 513 is formed in the interior of the die, within walls 511, in which a tapered guide pin 515 is mounted. The guide pin 515 extends upward through the opening to cavity 513, and is dimensioned to be inserted into the terminal convolution 28 of the coil which fits within cavity 513. The dies 504 of the present invention are thus able to accom-

modate coils having a terminal convolution which extends beyond a coil head, and to interconnect coils at points other than at the terminal ends of the coils.

[0033] The mechanics by which the innerspring assembler translates the carrier bars 506 with the attached dies 504 in the described vertical and lateral paths are now described with continuing reference to FIGS. 7A-7I, and additional reference to FIGS. 9A and 9B, 10 and 11. The carrier bars 506 (with attached dies 504) are not permanently attached to any other parts of the assembler. The carrier bars 506 are thus free to be translated vertically and laterally by elevator and indexer mechanisms in the innerspring assembler. Dependent upon position, the carrier bars 506 and dies 504 are supported either by fixed supports or retractable supports. As shown in FIGS. 9A and 9B, the lowermost carrier bar 506A rests on a clamp assembly piece supported by a lower elevator bar 632B. The uppermost carrier bar 506A is supported by pneumatically actuated pins 512 which are extended directly into bores in a side wall of the bar, or through bar tabs attached to the top of the carrier bar and aligned with the pins 512. Actuators 514, such as for example pneumatic cylinders, are controlled to extend and retract pins 512 relative to the carrier bars. The pins 512 on the coil entry side of the innerspring assembler are also referred to as the lag supports. The pins 512 on the opposite or exit side of the assembler (from which the assembled innerspring emerges) are alternatively referred to as the lead supports. On the exit side of the assembler (right side of FIGS. 9A and 9B, left side of FIG. 10A), the upper carrier bar 506B (in a position lower than upper carrier bar 506A) is supported by fixed supports 510, and the lower carrier bar 506B is supported by lead support pins 512.

[0034] As shown in FIG. 10A, a chain driven elevator assembly, indicated generally at 600, is used to vertically retract and converge the upper and lower carrier bars 506A and 506B through the sequence described with reference to FIGS. 7A-I. The elevator assembly 600 includes upper and lower sprockets 610, mounted upon axles 615, and upper and lower chains 620 engaged with sprockets 610. The opposing ends of the chains are connected by rods 625. Upper and lower chain blocks 630A and 630B extend perpendicularly from and between the rods 625, toward the center of the assembler. Lower axle 615 is connected to a drive motor (not shown) operative to rotate the associated sprocket 610 through a limited number of degrees sufficient to vertically translate the chain blocks 630A and 630B in opposite directions, to coverage or diverge, upon rotation of the sprockets. When the sprockets 610 are driven in a clockwise direction as shown in FIG. 10A, chain block 630A moves down, and chain block 630B moves up, and vice versa.

[0035] The chain blocks 630A and 630B are connected to corresponding upper and lower elevator bars 632A and 632B which run parallel to and substantially the entire length of the carrier bars. The upper and lower elevator bars 632A and 632B vertically converge and retract upon

the described partial rotation of sprockets 610. The upper lead and lag support pins 512 and associated actuators 514 are mounted on the upper elevator bar 632A to move vertically up or down with the elevator assembly.

[0036] The two parallel sets of upper and lower carrier bars, 506A and 506B, are laterally exchanged (as in FIG. 7I) by an indexer assembly indicated generally at 700 in FIG. 10A. The indexer assembly includes, at each end of the assembler, upper and lower pairs of gear racks 702, with a pinion 703 mounted for rotation between each the racks. One of each of the pairs of racks 702 is connected to a vertical push bar 706, and the other corresponding rack is journaled for lateral translation. The right and left vertical push bars 706 are each connected to a pivot arm 708 which pivots on an index slide bar 710 which extends from a one end of the assembler frame to the other, between the pairs of indexer gear racks. A drive rod 712 is linked to vertical push bar 706 at the intersection of the push bar with the pivot arm. The drive rod 712 is linearly actuated by a cylinder 714, such as a hydraulic or pneumatic cylinder. Driving the rod 712 out from cylinder 714 moves the vertical push bar 706 and the attached racks 702. The translation of the racks 702 attached to the vertical push bar 706 causes rotation of the pinions 703 which induces translation in the opposite direction of the opposing rack 702 of the rack pairs.

[0037] As further shown in FIG. 10B, for each pair of racks 702, one of the racks 702 carries or is secured to a linearly actuatable pawl 716, dimensioned to fit within an axial bore at the end of a carrier bar 506 (not shown). The corresponding opposing rack 702 carries or is attached to a guide 718 having an opening with a flat surface 719 dimensioned to receive the width of a carrier bar 506, flanked by opposed upstanding tapered flanges 721. As shown in FIG. 10A, on the lower half of the assembler, the lower rack 702 of the opposed rack pairs carries a guide 718 in which a lower carrier bar 506B (not shown) is positioned. The opposed corresponding rack 702 carries pawl 716 engaged in an axial bore in lower carrier bar 506A (not shown). An opposite arrangement is provided with respect to the upper pairs of racks 702. With the carrier bars 506 thus in contact with the indexer assembly, linear actuation of the drive rods 712 causes the carrier bars 506A and 506B to horizontally translate in opposite directions and exchange vertical plane positions (i.e. to swap), to accomplish the process step previously described with reference to the FIG. 7I.

[0038] The innerspring assembler of the invention further includes a clamping mechanism operative to laterally compress together the adjacent pairs of dies 504A and 504B (or carrier bars 506) when they are horizontally aligned (as described with reference to FIG. 7D), so that the coils in the dies are securely held together as they are fastened together by, for example, a helical lacing wire. As shown in FIG. 5 (and schematically depicted in FIGS. 7A-7I), the innerspring assembler includes upper and lower back-up bars 550 which are horizontally aligned with the corresponding carrier bars 506 during

the described inter-coil lacing operation. Each back-up bar 550 is intersected by or otherwise operatively connected to arms 562, 564 of a clamp assembly shown in FIG. 11. The clamp assembly 560 includes a fixed clamp arm 562, and a moving clamp arm 564, connected by linkage 566. A shaft 570 extending from a linear actuator 568, such as an air or hydraulic cylinder, is connected at a lower region to linkage 566. Extension of shaft 570 from actuator 568 causes the distal end 565 of the moving

5 clamp arm 564 to laterally translate away from the adjacent carrier bar 506 to an unclamped position. Conversely, retraction of the shaft 570 into the actuator 568 causes the distal end 565 of the moving clamp arm 564 to move toward the adjacent carrier bar 506, clamping it against 10 the horizontally adjacent carrier bar 506, and against the adjacent carrier bar 506 which backs up against the fixed clamp bar 562. The clamp assemblies 560 on the upper half of the assembler are mounted upon the assembler frame and does not move with the carrier bars and dies. 15 The clamp assemblies 560 on the lower half of the assembler are mounted on the elevator bar 632B to move with the carrier bars. Thus by operation of actuator 568 the clamp assemblies either hold adjacent rows of dies/cARRIER bars tightly together, or release them to allow the 20 described vertical and horizontal movements.

[0039] One or more of the dies 504 may be alternately configured to crimp and/or cut each of the helical lacing wires once it is fully engaged with two adjacent rows of coils. For example, as shown in FIG. 6B, a knuckler die 30 504K is attachable to a carrier bar at a selected location where the helical lacing wire is to be crimped or "knuckled" to secure it in place about the coils. The knuckler die 504K has a knuckle tool 524 mounted upon a sliding strike plate 525 which biased by springs 526 so that the 35 tip 527 of the knuckle tool 524 extends beyond an edge of the die. In the assembler, a linear actuator (not shown) such as a pneumatically driven push rod, is operative to strike the strike plate 525 to advance the knuckle tool 524 in the path of the strike plate to bring the tool into 40 contact with the lacing wire. Where upper and lower knuckler dies 504K are installed on the upper and lower carrier bars of the assembler, the linear actuator is provided with a fitting which contacts both the upper and lower strike plates of the knuckler dies simultaneously.

[0040] The invention further includes certain alternative means of lacing together rows of coils within the innerspring assembly machine. For example, as shown in FIGS. 17A-17G, lacer tooling 801 includes a guide ramp 802 upon which the terminal end of coils 2 are advanced 50 into position by a finger 804 which positions the coil ends within partable tooling 806. As shown in FIG. 17C, the downward travel of the finger 804 positions segments of the adjacent coils heads within complementary tools 806 which then clamp to form a lacing channel for insertion 55 of a helical lacing wire. Once laced together, the tools 806 part and the connected coils are advanced to allow for introduction of a subsequent row of coils. FIG. 17B illustrates a starting position, with the coil heads of a new

row of coils at left and a preceding row of coils engaged by the finger 804. In FIG. 17C, the finger is actuated downward to draw the coil head segments in between the parted tools 806. In FIG. 17D, the finger 804 then returns upward as the coil heads are laced together within the tools 806 which are placed tightly together about overlapping segments of the adjacent coil heads. In FIG. 17E, the tools 806 open to release the now connected coils which recoil upward to contact finger 804 (as in FIG. 17F), and the connected coils are indexed or advanced to the right in FIG. 17G to allow for introduction of a subsequent row of coils.

[0041] FIGS. 18A-18G illustrate still another alternative means and mechanism for lacing or otherwise connecting adjacent rows of coils. The coils are similarly advanced up a guide ramp 802 so that overlapping segments of adjacent coil heads are positioned directly over extendable tools 812. As shown in FIG. 18B, the tools 812 are laterally spread and, in FIG. 18C, extend vertically to straddle the overlapping coil segments, and clamp together thereabout as in FIG. 18D to securely hold the coils as they are laced together. The tools 812 then part and retract, as in FIGS. 18E and 18F, and the connected coils are indexed or advanced to the right in FIG. 18G and the process repeated.

[0042] FIGS. 19A-19F illustrate still another mechanism or means for lacing or interconnecting adjacent coils. Within the innerspring assembler are provided a series of upper and lower walking beam assemblies, indicated generally at 900. Each assembly 900 includes an arm 902 which supports dual coil-engaging tooling 904, mounted to articulate via an actuator arm 906. The tooling 904 includes cone or dome shaped fittings 905 configured for insertion into the open axial ends of the terminal ends of the coils. This correctly positions a pair of coils between the upper and lower assemblies for engagement of lacing tools 908 with segments of the coil heads (as shown in FIG. 19C). Once the lacing or attachment is completed, the assemblies 900 are actuated to laterally advance the attached coils to the right as shown in FIG. 19D. The assemblies 900 then retract vertically off the ends of the coils, and then retract laterally (for example to the left in FIG. 19F to receive the next row of coils).

[0043] The coil formers, conveyors, coil transfer machine and innerspring assembler are run simultaneously and in sync as controlled by a statistical process control system, such as an Allen-Bradley SLC-504 programmed to coordinate the delivery of coils by the genevas to the conveyors, the speed and start/stop operation of the conveyors the interface of the arms of the coil transfer machine with coils on the conveyors, and the timed presentation of rows of coils to the innerspring assembler, and operation of the innerspring assembler.

[0044] Although the invention has been described with reference to certain preferred and alternate embodiments, it is understood that numerous modifications and variations to the different component could be made by

those skilled in the art which are within the scope of the claims.

5 Claims

1. An automated innerspring assembly system (100) for producing innerspring assemblies (1) having a plurality of wire form coils (2) interconnected in an array, the automated innerspring assembly system (100) comprising:

at least one coil formation device (201, 202) arranged to form wire stock (110) into individual coils (2) configured for assembly in an innerspring assembly (1), and arranged to deliver individual coils to a coil conveyor (301, 302), a coil conveyor (301, 302) associated with the coil formation device (201, 202) and arranged to receive and engage coils (2) from the coil formation device and convey coils to a coil transfer machine (400), a coil transfer machine (400) arranged to remove coils (2) from the coil conveyor (301, 302) and present coils to an innerspring assembler (500), and

an innerspring assembler (500) arranged to receive and engage a plurality of coils (2) arranged in a row, and to position a received row of coils parallel and closely adjacent to a previously received row of coils,

characterized in that:

the innerspring assembler (500) is further arranged to fixedly compress two adjacent rows of coils (2) in a fixed position and interconnect the adjacent rows of coils with fastening means (510), and to advance interconnected rows of coils out of the assembler and receive and engage a subsequent row of coils, and

the innerspring assembler (500) comprises two pairs of upper and lower coil-engaging dies (504) mounted upon upper and lower carrier bars (506), means (600) for vertically converging and diverging the upper and lower carrier bars (506) relative to a row of coils (2) positioned between the upper and lower coil-engaging dies, and means (700) for laterally exchanging the position of a first pair of upper and lower carrier bars (506) with the position of a second pair of upper and lower carrier bars (506).

2. The automated innerspring assembly system of claim 1, wherein the coil-engaging dies (504) of the innerspring assembler (500) include a cavity (513) configured to receive a terminal convolution (26) of

the coil (2), and a contoured external surface (507) over which a portion of the coil fits, the contoured external surface further comprising a guide path (505) for passage of a wire (4) which interconnects the coils (2) of an innerspring assembly (1).

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3. The automated innerspring assembly system of claim 2, wherein the innerspring assembler further comprises a coil interconnection wire feeding apparatus (511) arranged to feed a wire (510) through aligned guide paths (505) of the coil-engaging dies (504) and around the portion of the coils which fit over the coil-engaging dies.
4. The automated innerspring assembly system of claim 1, further comprising a clamping mechanism (550, 560) arranged to clamp together horizontally adjacent coil-engaging dies (504) or carrier bars (506) to securely hold the dies for attachment of an interconnection wire (510), the clamping mechanism including a fixed clamp arm (562) and a moving clamp arm (564), and back-up bars (550) which fit over the fixed and moving clamp arms and which are aligned with the carrier bars (506).
5. The automated innerspring assembly system of claim 1, wherein the means (600) for vertically converging and diverging the upper and lower carrier bars (506) is an elevator assembly having upper and lower sprockets (610) with corresponding upper and lower chains (620) connected by rods (625), lifting blocks (630) attached to the rods, elevator bars (632) attached to the lifting blocks, and a rotation drive mechanism connected to an axle (615) of one of the sprockets (610).
6. The automated innerspring assembly system of claim 1, wherein the means (700) for laterally exchanging the position of a first pair of upper and lower carrier bars (506) with the position of a second pair of upper and lower carrier bars (506) comprises an indexing assembly having an upper and lower gear rack (702) journaled for lateral translation about a pinion gear (703), both the upper and lower gear racks (702) having means (716, 718) for engaging ends of the carrier bars (506).
7. An automated innerspring assembler (500) arranged to accept rows of prefabricated spring coils (2) and to interconnect the coils in a generally parallel arrangement to form an innerspring assembly (1), the innerspring assembler (500) comprising:

a frame (502) which supports first and second sets of coil-engaging dies (504), each set of coil-engaging dies having an upper row of dies positioned over a lower row of dies, the first and second sets of dies (504) being in a generally

parallel arrangement within the assembler (500),

characterized in that:

the rows of coil-engaging dies (504) are mounted upon carrier bars (506) supportable by fixed and moveable supports within the assembler (500),
 an elevator assembly (600) is arranged to engage with the carrier bars (506) and to move the carrier bars in a vertical dimension to separate the upper rows of dies (504) from the lower rows of dies (504) of the first or second set of dies a distance sufficient to allow positioning of a row of coils (2) between the upper and lower rows of dies, and to converge the upper and lower rows of dies upon an inserted row of coils, and an indexer assembly (700) is arranged to engage with the carrier bars (506) and to move the carrier bars in a horizontal dimension, and is further arranged to move a row of coils (2) engaged in upper and lower rows of dies (504) mounted on the carrier bars (506) engaged with the indexer assembly (700).

8. The innerspring assembler of claim 7, further comprising a clamping mechanism (550, 560) supported by the frame (502) and arranged to compress together laterally adjacent rows of dies (504).
9. The innerspring assembler of claim 7, further comprising coil interconnection means (511) for interconnecting rows of coils (2) held in the coil-engaging dies (504).
10. The innerspring assembler of claim 8, further comprising back-up bars (550) supported by the frame (502) and arranged to be placed in contact with the carrier bars (506) by the clamping mechanism (560).
11. The innerspring assembler of claim 7, further comprising lead and lag supports (512) which are controllably retractable and extendable to support the carrier bars (506) at different locations within the innerspring assembler (500).
12. The innerspring assembler of claim 7, further comprising at least one knuckler device (504K) mounted upon a carrier bar (506).
13. The innerspring assembler of claim 9, further comprising means (524) for cutting a coil interconnection fastening means (510) attached to the coils (2) by the coil interconnection means (511).
14. The innerspring assembler of claim 7, wherein the

elevator assembly (600) comprises right and left pairs of upper and lower sprockets (610), a chain assembly (620) engaged with each pair of sprockets, and lifting blocks (630) attached to each chain assembly, the lifting blocks (630) being arranged to engage the carrier bars (506) to move the carrier bars in a vertical dimension.

15. The innerspring assembler of claim 7, wherein the indexer assembly (700) comprises upper and lower toothed racks (702) engaged with a pinion gear (703), means (714) for linearly actuating at least one of the racks, and carrier bar engagement means (716, 718) attached to at least one of the toothed racks (702). 10
16. A coil-engaging die (504) arranged to engage an end of a coil (2) in an apparatus which attaches coils together to form an innerspring assembly (1), the coil-engaging die (504) having a generally rectangular coil body with side walls (511),
characterized in that the side walls (511) surround a cavity (513) within the coil body, the cavity (513) being dimensioned to receive an axial end (26) of a coil (2) whereby an end of a coil engaged with the die is within the side walls (511) of the die and a longitudinal axis of a coil engaged with the die extends generally orthogonally from the coil body. 20
17. The coil-engaging die of claim 16, wherein outside edges of the side walls (511) are tapered and at least one of the walls includes a top surface (509) arranged to come in contact with a portion of a coil head (22) of a coil (2) engaged with the die. 30
18. The coil-engaging die of claim 16, further comprising a tapered guide pin (515) attached to the coil body within the cavity (513) and extending generally parallel to the side walls (511). 40
19. The coil-engaging die of claim 16, further comprising a passageway (505) formed in an exterior surface of at least one of the side walls (511) arranged to allow passage of coil fastening means past the die and to engage a portion of a coil (2) engaged with the die. 45
20. An innerspring assembly machine (500) arranged to sequentially and automatically interconnect a plurality of coils (2) into a matrix-like array to form an innerspring assembly (1) for use as a flexible support structure, the innerspring assembly machine (500) comprising:
 a frame (502) on which is mounted: 55
 lead and lag supports (512),
 an elevator assembly (600), and

an indexer assembly (700),

characterized in that the innerspring assembly machine (500) further comprises:

two parallel sets of carrier bars (506), each set of carrier bars having an upper carrier bar and a lower carrier bar, the carrier bars being supportable within the frame (502) by the lead and lag supports (512), each carrier bar being engageable with the elevator assembly (600) and the indexer assembly (700), the elevator assembly (600) being arranged to alter vertical spacing between the upper and lower carrier bars (506) of a carrier bar set, the indexer assembly (700) being arranged to laterally exchange the positions of the upper carrier bars of the two carrier bar sets and to laterally exchange the positions of the lower carrier bars of the two carrier bar sets, and
 a plurality of coil-engaging dies (504) attached to each of the carrier bars (506), whereby a first plurality of pre-formed coils (2) can be introduced into the frame (502) of the innerspring assembly machine (500) and engaged by the dies (504) on the upper and lower carrier bars (506) of a first carrier bar set by operation of the elevator assembly (600), and the positions of the carrier bars (506) of the first carrier bar set can be laterally exchanged with the positions of the carrier bars (506) of a second carrier bar set, whereupon a second plurality of pre-formed coils (2) can be introduced into the frame (502) of the innerspring assembly machine (500) and engaged by the dies (504) on the upper and lower carrier bars (506) of the second carrier bar set by operation of the elevator assembly (600), whereupon the first and second pluralities of pre-formed coils (2) are interconnected by interconnection means (511) proximate to the innerspring assembly machine operative to insert fastening means (4) between the dies (504) of the first and second sets of carrier bars (506).

50 Patentansprüche

1. Automatisches Federkernanordnungssystem (100) zur Herstellung von Federkernanordnungen (1) mit einer Mehrzahl von Drahtformfedern (2), die in einer Gruppierung miteinander verbunden sind, wobei das automatische Federkernanordnungssystem (100) Folgendes umfasst:

- mindestens eine Federbildungsvorrichtung (201, 202), die so angeordnet ist, dass sie aus einem Drahtvorrat (110) einzelne Federn (2) bildet, die zur Anordnung in einer Federkernanordnung (1) konfiguriert sind, und so, dass sie einzelne Federn an einen Federförderer (301, 302) liefert, einen Federförderer (301, 302), der der Federbildungsvorrichtung (201, 202) zugeordnet und so angeordnet ist, dass er Federn (2) von der Federbildungsvorrichtung aufnimmt und in Eingriff nimmt und Federn zu einer Federtransfomaschine (400) befördert, eine Federtransfomaschine (400), die angeordnet ist, um Federn (2) vom Federförderer (301, 302) zu entfernen und Federn einer Federkernanordnungsvorrichtung (500) vorzulegen, und eine Federkernanordnungsvorrichtung (500), die so angeordnet ist, dass sie eine Mehrzahl von in einer Reihe angeordneten Federn (2) aufnimmt und in Eingriff nimmt, und so, dass sie eine aufgenommene Reihe von Federn parallel zu einer zuvor aufgenommenen Reihe von Federn und eng benachbart zu ihr positioniert, **dadurch gekennzeichnet, dass** die Federkernanordnungsvorrichtung (500) ferner so angeordnet ist, dass sie zwei benachbarte Reihen von Federn (2) fest in einer festgelegten Position zusammendrückt und die benachbarten Reihen von Federn mit Befestigungsmitteln (510) miteinander verbindet, und dass sie miteinander verbundene Reihen von Federn aus der Anordnungsvorrichtung vorschiebt und eine nachfolgende Reihe von Federn aufnimmt und in Eingriff nimmt, und die Federkernanordnungsvorrichtung (500) zwei Paare oberer und unterer Federeingriffsmatrizen (504), die an oberen und unteren Trägerstangen (506) montiert sind, ein Mittel (600), um die obere und die untere Trägerstange (506) bezüglich einer Reihe von Federn (2), die zwischen den oberen und unteren Federeingriffsmatrizen positioniert sind, vertikal zusammen- und auseinanderzuführen, und ein Mittel (700) umfasst, um die Position eines ersten Paars oberer und unterer Trägerstangen (506) seitlich gegen die Position eines zweiten Paars oberer und unterer Trägerstangen (506) zu tauschen.
2. Automatisches Federkernanordnungssystem nach Anspruch 1, wobei die Federeingriffsmatrice (504) der Federkernanordnungsvorrichtung (500) einen Hohlraum (513), der zur Aufnahme einer Endwendung (26) der Feder (2) konfiguriert ist, und eine konturierte Außenfläche (507) aufweist, über die ein Abschnitt der Feder passt, wobei die konturierte Außenfläche ferner eine Führungsbahn (505) für den Durchgang eines Drahts (4) umfasst, der die Federn (2) einer Federkernanordnung (1) miteinander verbindet.
- 5 3. Automatisches Federkernanordnungssystem nach Anspruch 2, wobei die Federkernanordnungsvorrichtung ferner eine Vorrichtung (511) zur Zuführung von Federverbindungsdräht umfasst, die dazu angeordnet ist, einen Draht (510) durch ausgerichtete Führungsbahnen (505) der Federeingriffsmatrizen (504) und um den Abschnitt der Federn zu führen, der über die Federeingriffsmatrizen passt.
- 10 4. Automatisches Federkernanordnungssystem nach Anspruch 1, ferner umfassend einen Klemmmechanismus (550, 560), der so angeordnet ist, dass er horizontal benachbarte Federeingriffsmatrizen (504) oder Trägerstangen (506) zusammenklemmt, um die Matrizen zum Anbringen eines Verbindungsdrähts (510) sicher zu halten, wobei der Klemmmechanismus einen feststehenden Klemmarm (562) und einen beweglichen Klemmarm (564) und Hinterlegleisten (550) aufweist, die über den feststehenden und den beweglichen Klemmarm passen und auf die Trägerstangen (506) ausgerichtet sind.
- 15 5. Automatisches Federkernanordnungssystem nach Anspruch 1, wobei das Mittel (600) zum vertikalen Zusammen- und Auseinanderführen der oberen und unteren Trägerstangen (506) eine Liftanordnung ist, die obere und untere Kettenräder (610) mit entsprechenden oberen und unteren Ketten (620), die über Stäbe (625) verbunden sind, an die Stäbe angebrachte Hebeblöcke (630), an die Hebeblöcke angebrachte Liftstangen (632) und einen Drehantriebsmechanismus, der mit einer Achse (615) eines der Kettenräder (610) verbunden ist, hat.
- 20 6. Automatisches Federkernanordnungssystem nach Anspruch 1, wobei das Mittel (700), um die Position eines ersten Paars oberer und unterer Trägerstangen (506) seitlich gegen die Position eines zweiten Paars oberer und unterer Trägerstangen (506) zu tauschen, eine Weiterschaltanordnung mit einer oberen und einer unteren Zahnstange (702) umfasst, die zur seitlichen Translation um ein Ritzel (703) gelagert ist, wobei sowohl die obere als auch die untere Zahnstange (702) Mittel (716, 718) zur Ineingriffnahme von Enden der Trägerstangen (506) hat.
- 25 7. Automatische Federkernanordnungsvorrichtung (500), die so angeordnet ist, dass sie Reihen von vorgefertigten Federn (2) aufnimmt und die Federn zur Bildung einer Federkernanordnung (1) in einer allgemein parallelen Anordnung miteinander verbindet, wobei die Federkernanordnungsvorrichtung (500) Folgendes umfasst:
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- einen Rahmen (502), der einen ersten und einen zweiten Satz Federeingriffsmatrizen (504) stützt, wobei jeder Satz Federeingriffsmatrizen eine über einer unteren Reihe von Matrizen positionierte obere Reihe von Matrizen hat, wobei der erste und der zweite Satz von Matrizen (504) allgemein parallel in der Anordnungsvorrichtung (500) angeordnet sind,
- dadurch gekennzeichnet, dass**
- die Reihen von Federeingriffsmatrizen (504) an Trägerstangen (506) montiert sind, die von feststehenden und beweglichen Stützen in der Anordnungsvorrichtung (500) gestützt werden können,
- 10 eine Liftanordnung (600) so angeordnet ist, dass sie in die Trägerstangen (506) eingreift und die Trägerstangen in einer vertikalen Dimension bewegt, um die oberen Reihen von Matrizen (504) von den unteren Reihen von Matrizen (504) des ersten und des zweiten Satzes Matrizen so weit zu trennen, dass eine Reihe von Federn (2) zwischen die oberen und unteren Reihen von Matrizen positioniert werden kann, und die oberen und unteren Reihen von Matrizen auf eine eingeführte Reihe von Federn zusammenzuführen, und
- 15 eine Weiterschaltanordnung (700) so angeordnet ist, dass sie in die Trägerstangen (506) eingreift und die Trägerstangen in einer horizontalen Dimension bewegt, und weiter so angeordnet ist, dass sie eine Reihe von Federn (2) bewegt, die mit oberen und unteren Reihen von Matrizen (504) in Eingriff stehen, die an den Trägerstangen (506) montiert sind, die mit der Weiterschaltanordnung (700) in Eingriff stehen.
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12. Federkernanordnungsvorrichtung nach Anspruch 7, ferner umfassend mindestens eine Crimpvorrichtung (504K), die an einer Trägerstange (506) montiert ist.
13. Federkernanordnungsvorrichtung nach Anspruch 9, ferner umfassend Mittel (524) zum Schneiden eines Federverbindungsbefestigungsmittels (510), das über das Federverbindungsmittel (511) an den Federn (2) angebracht ist.
14. Federkernanordnungsvorrichtung nach Anspruch 7, wobei die Liftanordnung (600) rechte und linke Paare oberer und unterer Kettenräder (610), eine Kettenanordnung (620), die mit jedem Paar Kettenräder in Eingriff steht, und Hebeblöcke (630) umfasst, die an jeder Kettenanordnung angebracht und so angeordnet sind, dass sie die Trägerstangen (506) in Eingriff nehmen, um die Trägerstangen in einer vertikalen Dimension zu bewegen.
15. Federkernanordnungsvorrichtung nach Anspruch 7, wobei die Weiterschaltanordnung (700) obere und untere Zahnstangen (702), die mit einem Ritzel (703) in Eingriff stehen, ein Mittel (714) zur linearen Betätigung mindestens einer der Zahnstangen, und an mindestens einer der Zahnstangen (702) angebrachte Trägerstangeneingriffsmittel (716, 718) umfasst.
16. Federeingriffsmatrice (504), die so angeordnet ist, dass sie ein Ende einer Feder (2) in einem Gerät in Eingriff nimmt, das Federn zum Bilden einer Federkernanordnung (1) aneinander anbringt, wobei die Federeingriffsmatrice (504) einen allgemein rechteckigen Federkörper mit Seitenwänden (511) hat, **dadurch gekennzeichnet, dass** die Seitenwände (511) einen Hohlraum (513) im Federkörper umgeben, wobei der Hohlraum (513) so bemessen ist, dass er ein axiales Ende (26) einer Feder (2) aufnimmt, wodurch ein mit der Matrize in Eingriff stehendes Ende einer Feder innerhalb der Seitenwände (511) der Matrize liegt und eine mit der Matrize in Eingriff stehende Längsachse einer Feder sich allgemein orthogonal vom Federkörper erstreckt.
17. Federeingriffsmatrice nach Anspruch 16, wobei sich äußere Ränder der Seitenwände (511) verjüngen und mindestens eine der Wände eine obere Fläche (509) aufweist, die so angeordnet ist, dass sie mit einem Abschnitt eines Federkopfs (22) einer mit der Matrize in Eingriff stehenden Feder (2) in Kontakt kommt.
18. Federeingriffsmatrice nach Anspruch 16, ferner umfassend einen konisch zulaufenden Führungsstift

(515), der im Hohlraum (513) am Federkörper angebracht ist und sich allgemein parallel zu den Seitenwänden (511) erstreckt.

19. Federeingriffsmatrice nach Anspruch 16, ferner umfassend einen Durchgang (505), der in einer Außenfläche mindestens einer der Seitenwände (511) ausgebildet und so angeordnet ist, dass er gestattet, dass Federbefestigungsmittel an der Matrize vorbegehen, und so, dass er einen Abschnitt einer mit der Matrize in Eingriff stehenden Feder (2) in Eingriff nimmt. 5

20. Federkernanordnungsmachine (500), die so angeordnet ist, dass sie eine Mehrzahl von Federn (2) nacheinander und automatisch zu einer Anordnung nach der Art einer Matrix miteinander verbindet, um eine Federkernanordnung (1) zur Verwendung als eine flexible Stützstruktur zu bilden, wobei die Federkernanordnungsmachine (500) Folgendes umfasst: 15

einen Rahmen (502), an dem Folgendes montiert ist:

vordere und hintere Stützen (512),
eine LIFTANORDNUNG (600) und
eine WEITERSCHALTANORDNUNG (700),

dadurch gekennzeichnet, dass die Federkernanordnungsmachine (500) ferner Folgendes umfasst:

zwei parallele Sätze Trägerstangen (506), wobei jeder Satz Trägerstangen eine obere Trägerstange und eine untere Trägerstange hat, wobei die Trägerstangen im Rahmen (502) durch die vordere und die hintere Stütze (512) gestützt werden können und jede Trägerstange mit der LIFTANORDNUNG (600) und der WEITERSCHALTANORDNUNG (700) in Eingriff kommen kann, wobei die LIFTANORDNUNG (600) so angeordnet ist, dass sie den vertikalen Abstand zwischen den oberen und unteren Trägerstangen (506) eines Trägerstangensatzes ändert und die WEITERSCHALTANORDNUNG (700) so angeordnet ist, dass sie die Positionen der oberen Trägerstangen der beiden Trägerstangensätze seitlich tauscht und die Positionen der unteren Trägerstangen der beiden Trägerstangensätze seitlich tauscht, und eine Mehrzahl von Federeingriffsmatrizen (504), die an jeder der Trägerstangen (506) angebracht sind, wodurch eine erste Mehrzahl von vorgeformten Federn (2) durch Betätigung der LIFTANORDNUNG (600) in den Rahmen (502) der Federkernanordnungsmachine (500) eingeführt und von den Matrizen (504) an den oberen und unteren Trägerstangen (506) eines ersten Trägerstangensatzes in Eingriff genommen werden kann und die Positionen der Trägerstangen (506) des ersten Trägerstangensatzes seitlich gegen die Positionen der Trägerstangen (506) eines zweiten Trägerstangensatzes getauscht werden können, wonach eine zweite Mehrzahl von vorgeformten Federn (2) durch Betätigung der LIFTANORDNUNG (600) in den Rahmen (502) der Federkernanordnungsmachine (500) eingeführt und von den Matrizen (504) an den oberen und unteren Trägerstangen (506) des zweiten Trägerstangensatzes in Eingriff genommen werden kann, wonach die erste und die zweite Mehrzahl von vorgeformten Federn (2) durch das Verbindungsmittel (511) in der Nähe der Federkernanordnungsmachine, die dahingehend wirkt, Befestigungsmittel (4) zwischen die Matrizen (504) des ersten und des zweiten Satzes Trägerstangen (506) einzufügen, miteinander verbunden werden.

maschine (500) eingeführt und von den Matrizen (504) an den oberen und unteren Trägerstangen (506) eines ersten Trägerstangensatzes in Eingriff genommen werden kann und die Positionen der Trägerstangen (506) des ersten Trägerstangensatzes seitlich gegen die Positionen der Trägerstangen (506) eines zweiten Trägerstangensatzes getauscht werden können, wonach eine zweite Mehrzahl von vorgeformten Federn (2) durch Betätigung der LIFTANORDNUNG (600) in den Rahmen (502) der Federkernanordnungsmachine (500) eingeführt und von den Matrizen (504) an den oberen und unteren Trägerstangen (506) des zweiten Trägerstangensatzes in Eingriff genommen werden kann, wonach die erste und die zweite Mehrzahl von vorgeformten Federn (2) durch das Verbindungsmittel (511) in der Nähe der Federkernanordnungsmachine, die dahingehend wirkt, Befestigungsmittel (4) zwischen die Matrizen (504) des ersten und des zweiten Satzes Trägerstangen (506) einzufügen, miteinander verbunden werden.

Revendications

1. Système automatisé d'assemblage de ressorts intérieurs (100) pour produire des ensembles de ressorts intérieurs (1) ayant une pluralité de spirales formées en fil métallique (2) interconnectées dans un groupement, ce système automatisé d'assemblage de ressorts intérieurs (100) comprenant :

au moins un dispositif de formation de spirales (201, 202) agencé de façon à former du fil machine (110) en des spirales individuelles (2) configurées de façon à être assemblées dans un ensemble de ressorts intérieurs (1), et agencé de façon à fournir des spirales individuelles à un transporteur de spirales (301, 302), un transporteur de spirales (301, 302) associé au dispositif de formation de spirales (201, 202) et agencé de façon à recevoir des spirales (2) du dispositif de formation de spirales, à s'engager avec elles et à transporter les spirales à une machine de transfert de spirales (400), une machine de transfert de spirales (400) agencée de façon à enlever les spirales (2) du transporteur de spirales (301, 302) et à présenter les spirales à un assemeleur de ressorts intérieurs (500), et un assemeleur de ressorts intérieurs (500) agencé de façon à recevoir une pluralité de spirales (2) disposées en une rangée et à s'engager avec elles, et à positionner une rangée de

spirales reçue de manière parallèle et étroitement adjacente à une rangée de spirales reçue antérieurement,
caractérisé en ce que :

- l'assembleur de ressorts intérieurs (500) est agencé en outre de façon à comprimer de manière fixe deux rangées adjacentes de spirales (2) dans une position fixe et à interconnecter les rangées adjacentes de spirales avec des moyens d'attache (510), et à avancer les rangées interconnectées de spirales hors de l'assembleur et à recevoir une rangée suivante de spirales et à s'engager avec elles, et **en ce que**
 l'assembleur de ressorts intérieurs (500) comprend deux paires de matrices supérieures et inférieures s'engageant avec les spirales (504) montées sur des barres porte-matrices supérieures et inférieures (506), un moyen (600) pour faire converger et diverger verticalement les barres porte-matrices supérieures et inférieures (506) par rapport à une rangée de spirales (2) positionnées entre les matrices supérieures et inférieures s'engageant avec les spirales, et un moyen (700) pour échanger latéralement la position d'une première paire des barres porte-matrices supérieure et inférieure (506) avec la position d'une deuxième paire de barres porte-matrices supérieure et inférieure (506).
2. Système automatisé d'assemblage de ressorts intérieurs selon la revendication 1, dans lequel les matrices s'engageant avec les spirales (504) de l'assembleur de ressorts intérieurs (500) comportent une cavité (513) configurée de façon à recevoir une convolution terminale (26) de la spirale (2), et une surface externe profilée (507) au-dessus de laquelle une partie de la spirale s'adapte, cette surface externe profilée comportant en outre un chemin de guidage (505) pour le passage d'un fil métallique (4) qui interconnecte les spirales (2) d'un ensemble de ressorts intérieurs (1).
 3. Système automatisé d'assemblage de ressorts intérieurs selon la revendication 2, dans lequel l'assembleur de ressorts intérieurs comprend en outre un appareil d'alimentation de fil métallique d'interconnexion de spirales (511) agencé de façon à alimenter un fil métallique (510) à travers des chemins de guidage alignés (505) des matrices s'engageant avec les spirales (504) et autour de la partie des spirales qui s'adapte au-dessus des matrices s'engageant avec les spirales.
 4. Système automatisé d'assemblage de ressorts intérieurs selon la revendication 1, dans lequel les matrices s'engageant avec les spirales (504) sont positionnées de manière à être alignées avec les barres porte-matrices supérieures et inférieures (506) de l'assembleur de ressorts intérieurs (500) de façon à faciliter l'interconnection des rangées de spirales (2) avec les matrices s'engageant avec les spirales (504).

rieurs selon la revendication 1, comprenant en outre un mécanisme de serrage (550, 560) agencé de façon à serrer ensemble des matrices s'engageant avec les spirales (504) ou des barres porte-matrices (506) horizontalement adjacentes de façon à maintenir les matrices de manière ferme pour permettre d'attacher un fil métallique d'interconnexion (510), ce mécanisme de serrage comprenant un bras de serrage fixe (562) et un bras de serrage mobile (564), et des barres de maintien (550) qui s'adaptent au-dessus des bras de serrage fixe et mobile et qui sont alignées avec les barres porte-matrices (506).

5. Système automatisé d'assemblage de ressorts intérieurs selon la revendication 1, dans lequel le moyen (600) pour faire converger et diverger verticalement les barres porte-matrices supérieures et inférieures (506) est un ensemble élévateur ayant des pignons supérieurs et inférieurs (610) avec des chaînes supérieure et inférieure correspondantes (620) reliées par des tiges (625), des blocs de soulèvement (630) attachés aux tiges, des barres élévatrices (632) attachées aux blocs de soulèvement, et un mécanisme d' entraînement de rotation relié à un axe (615) d'un des pignons (610).
6. Système automatisé d'assemblage de ressorts intérieurs selon la revendication 1, dans lequel le moyen (700) pour échanger latéralement la position d'une première paire de barres porte-matrices supérieure et inférieure (506) avec la position d'une deuxième paire de barres porte-matrices supérieure et inférieure (506) comprend un ensemble d'indexage ayant une crémaillère d'engrenage supérieure et inférieure (702) pourvue de tourillons pour la translation latérale autour d'un pignon d'engrenage (703), ces crémaillères d'engrenage supérieure et inférieure (702) ayant toutes deux des moyens (716, 718) pour s'engager avec les extrémités des barres porte-matrices (506).
7. Assembleur automatisé de ressorts intérieurs (500) agencé de façon à accepter des rangées de spirales de ressort préfabriquées (2) et à interconnecter ces spirales dans une disposition généralement parallèle de façon à former un ensemble de ressorts intérieurs (1), cet assembleur de ressorts intérieurs (500) comprenant :

un bâti (502) qui supporte un premier et un deuxième ensemble de matrices s'engageant avec les spirales (504), chaque ensemble de matrices s'engageant avec les spirales ayant une rangée supérieure de matrices positionnée au dessus d'une rangée inférieure de matrices, ce premier et ce deuxième ensemble de matrices (504) étant dans une disposition généralement parallèle à l'intérieur de l'assembleur

(500),
caractérisé en ce que :

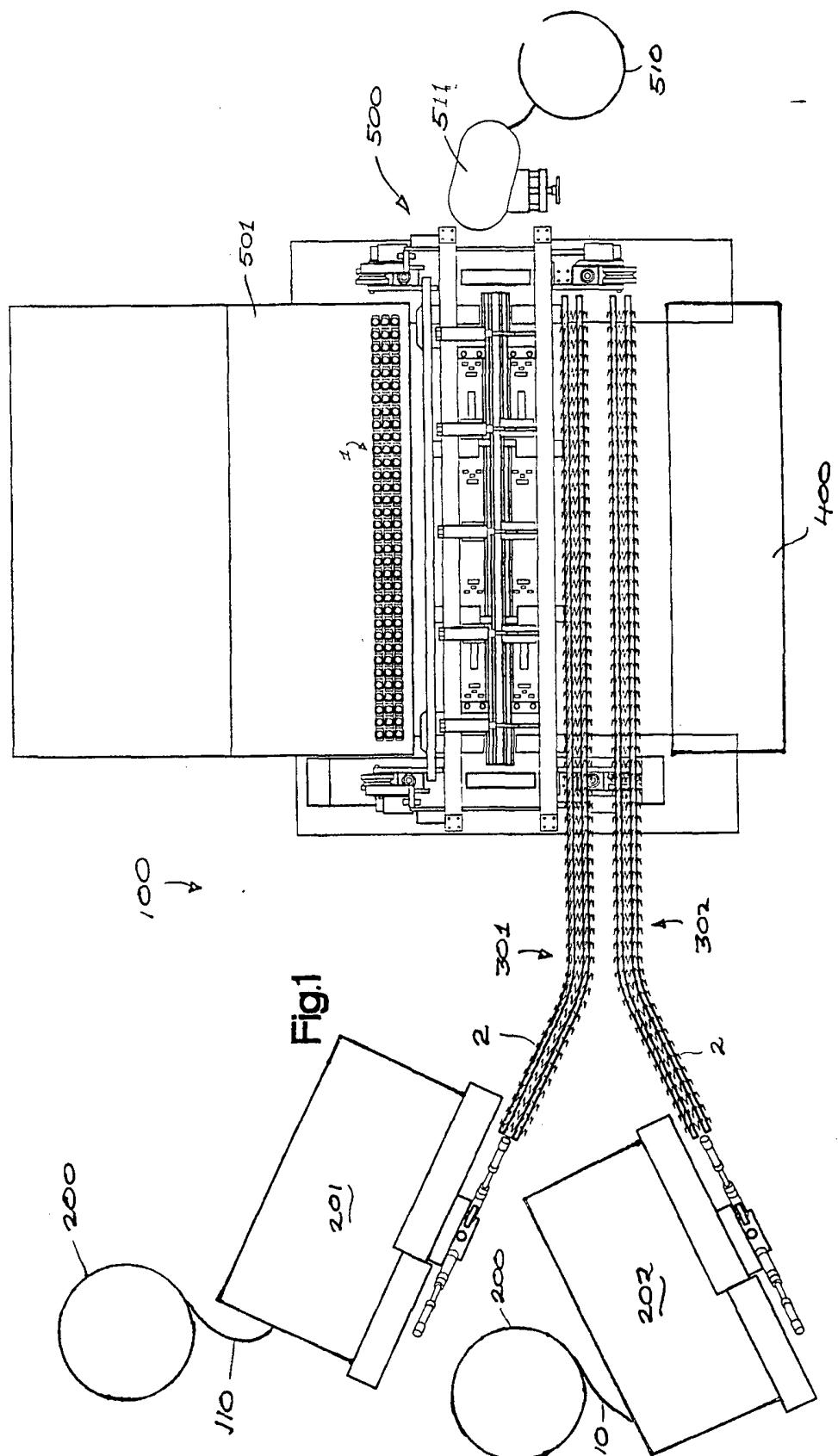
les rangées de matrices s'engageant avec les spirales (504) sont montées sur les barres porte-matrices (506) pouvant être supportées par des supports fixes et mobiles à l'intérieur de l'assembleur (500), un ensemble élévateur (600) est agencé de façon à s'engager avec les barres porte-matrices (506) et à bouger les barres porte-matrices dans une dimension verticale pour séparer les rangées supérieures de matrices (504) des rangées inférieures de matrices (504) du premier et du deuxième ensemble de matrices d'une distance suffisante pour permettre le positionnement d'une rangée de spirales (2) entre les rangées supérieures et inférieures de matrices, et pour faire converger les rangées supérieures et inférieures de matrices sur une rangée de spirales insérée, et **en ce que** un ensemble indexeur (700) est agencé de façon à s'engager avec les barres porte-matrices (506) et à bouger les barres porte-matrices dans une dimension horizontale, et est agencé en outre de façon à bouger une rangée de spirales (2) engagée dans les rangées supérieures et inférieures de matrices (504) montées sur les barres porte-matrices (506) engagées avec l'ensemble indexeur (700).

- 8. Assembleur de ressorts intérieurs selon la revendication 7, comprenant en outre un mécanisme de serrage (550, 560) supporté par le bâti (502) et agencé de façon à comprimer ensemble des rangées de matrices (504) latéralement adjacentes.
- 9. Assembleur de ressorts intérieurs selon la revendication 7, comprenant en outre un moyen d'interconnexion de spirales (511) pour interconnecter des rangées de spirales (2) maintenues dans les matrices s'engageant avec les spirales (504).
- 10. Assembleur de ressorts intérieurs selon la revendication 8, comprenant en outre des barres de maintien (550) supportées par le bâti (502) et agencées de façon à être placées en contact avec les barres porte-matrices (506) par le mécanisme de serrage (560).
- 11. Assembleur de ressorts intérieurs selon la revendication 7, comprenant en outre des supports d'avance et de recul (512) qui sont rétractables et extensibles de manière contrôlable de façon à supporter les barres porte-matrices (506) à différents emplacements à l'intérieur de l'assembleur de ressorts inté-

- 5 rieurs (500).
- 12. Assembleur de ressorts intérieurs selon la revendication 7, comprenant en outre au moins un dispositif de sertissage (504K) monté sur une barre porte-matrice (506).
- 10 13. Assembleur de ressorts intérieurs selon la revendication 9, comprenant en outre un moyen (524) pour couper un moyen d'attache d'interconnexion de spirales (510) attaché aux spirales (2) par le moyen d'interconnexion de spirales (511).
- 15 14. Assembleur de ressorts intérieurs selon la revendication 7, dans lequel l'ensemble élévateur (600) comprend des paires gauche et droite de pignons supérieurs et inférieurs (610), un ensemble chaîne (620) engagé avec chaque paire de pignons, et des blocs de soulèvement (630) attachés à chaque ensemble chaîne, ces blocs de soulèvement (630) étant agencés de façon à s'engager avec les barres porte-matrices (506) pour bouger les barres porte-matrices dans une dimension verticale.
- 20 25 15. Assembleur de ressorts intérieurs selon la revendication 7, dans lequel l'ensemble indexeur (700) comprend des crémaillères dentées supérieure et inférieure (702) engagées avec un pignon d'engrenage (703), un moyen (714) pour actionner linéairement au moins une des crémaillères, et des moyens d'engagement de barres porte-matrices (716, 718) attachés à au moins une des crémaillères dentées (702).
- 30 35 16. Matrice s'engageant avec une spirale (504) agencée de façon à s'engager avec une extrémité d'une spirale (2) dans un appareil qui attache les spirales ensemble pour former un ensemble de ressorts intérieurs (1), cette matrice s'engageant avec une spirale (504) ayant un corps de spirale généralement rectangulaire avec des parois latérales (511), **caractérisée en ce que** les parois latérales (511) entourent une cavité (513) à l'intérieur du corps de spirale, cette cavité (513) étant dimensionnée de façon à recevoir une extrémité axiale (26) d'une spirale (2), comme quoi une extrémité d'une spirale engagée avec la matrice est à l'intérieur des parois latérales (511) de la matrice et un axe longitudinal d'une spirale engagée avec la matrice s'étend généralement orthogonalement depuis le corps de spirale.
- 40 45 50 17. Matrice s'engageant avec une spirale selon la revendication 16, dans laquelle les bords extérieurs des parois latérales (511) sont tronconiques et au moins une des parois comporte une surface supérieure (509) agencée de façon à entrer en contact avec une partie d'une tête de spirale (22) d'une spirale (2) engagée avec la matrice.

18. Matrice s'engageant avec une spirale selon la revendication 16, comprenant en outre un axe de guidage conique (515) attaché au corps de spirale à l'intérieur de la cavité (513) et s'étendant généralement parallèlement aux parois latérales (511). 5
19. Matrice s'engageant avec une spirale selon la revendication 16, comprenant en outre un passage (505) formé dans une surface extérieure d'au moins une des parois latérales (511) agencé de façon à permettre le passage d'un moyen d'attache de spirale au-delà de la matrice et à s'engager avec une partie d'une spirale (2) engagée avec la matrice. 10
20. Machine d'assemblage de ressorts intérieurs (500) agencée de façon à interconnecter séquentiellement et automatiquement une pluralité de spirales (2) en un groupement semblable à un ensemble matriciel pour former un ensemble de ressorts intérieurs (1) destiné à être utilisé comme structure de support flexible, cette machine d'assemblage de ressorts intérieurs (500) comprenant : 15
20
- un bâti (502) sur lequel sont montés : 25
- des supports d'avance et de recul (512),
un ensemble élévateur (600), et
un ensemble indexeur (700),
- caractérisée en ce que** cette machine d'assemblage de ressorts intérieurs (500) comprend en outre : 30
- deux ensembles parallèles de barres porte-matrices (506), chaque ensemble de barres porte-matrices ayant une barre porte-matrice supérieure et une barre porte-matrice inférieure, les barres porte-matrices pouvant être supportées à l'intérieur du bâti (502) par les supports d'avance et de recul (512), 35
40
chaque barre porte-matrice pouvant être engagée avec l'ensemble élévateur (600) et l'ensemble indexeur (700), l'ensemble élévateur (600) étant agencé de façon à modifier l'écartement vertical entre les barres porte-matrices supérieure et inférieure (506) d'un ensemble de barres porte-matrices, l'ensemble indexeur (700) étant agencé de façon à échanger latéralement les positions des barres porte-matrices supérieures des deux ensembles de barres porte-matrices et à échanger latéralement les positions des barres porte-matrices inférieures des deux ensembles de barres porte-matrices, et 45
50
55
une pluralité de matrices s'engageant avec les spirales (504) attachées à chacune des barres porte-matrices (506), ce qui fait

qu'une première pluralité de spirales pré-formées (2) peuvent être introduites dans le bâti (502) de la machine d'assemblage de ressorts intérieurs (500) et engagées par les matrices (504) sur les barres porte-matrices supérieure et inférieure (506) d'un premier ensemble de barres porte-matrices par l'actionnement de l'ensemble élévateur (600), et les positions des barres porte-matrices (506) du premier ensemble de barres porte-matrices peuvent être échangées latéralement avec les positions des barres porte-matrices (506) d'un deuxième ensemble de barres porte-matrices, après quoi une deuxième pluralité de spirales pré-formées (2) peuvent être introduites dans le bâti (502) de la machine d'assemblage de ressorts intérieurs (500) et engagées par les matrices (504) sur les barres porte-matrices supérieure et inférieure (506) du deuxième ensemble de barres porte-matrices par l'actionnement de l'ensemble élévateur (600), après quoi la première et la deuxième pluralité de spirales pré-formées (2) sont interconnectées par un moyen d'interconnexion (511) à proximité immédiate de la machine d'assemblage de ressorts intérieurs opérant de façon à insérer le moyen d'attache (4) entre les matrices (504) du premier et du deuxième ensemble de barres porte-matrices (506).



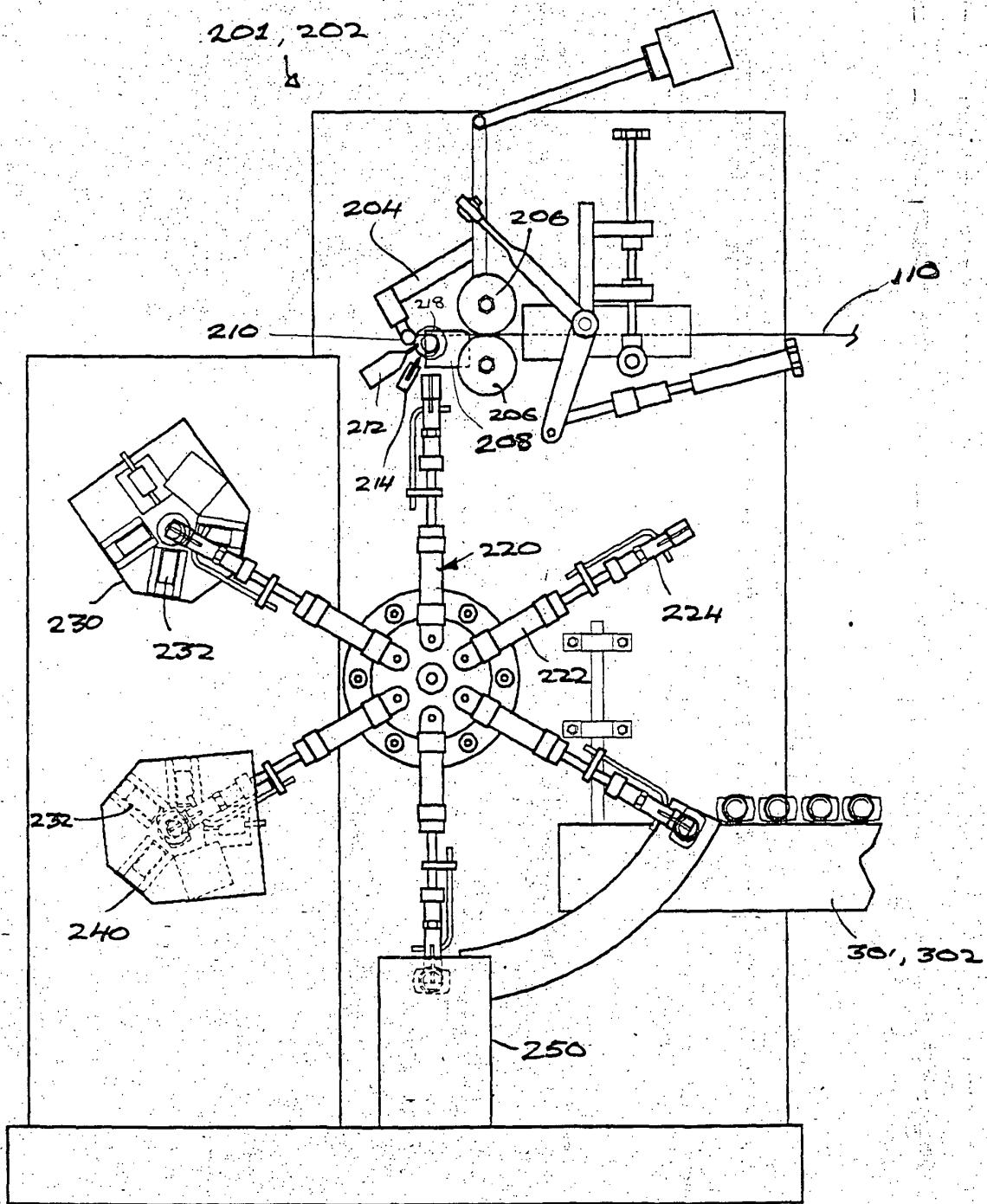
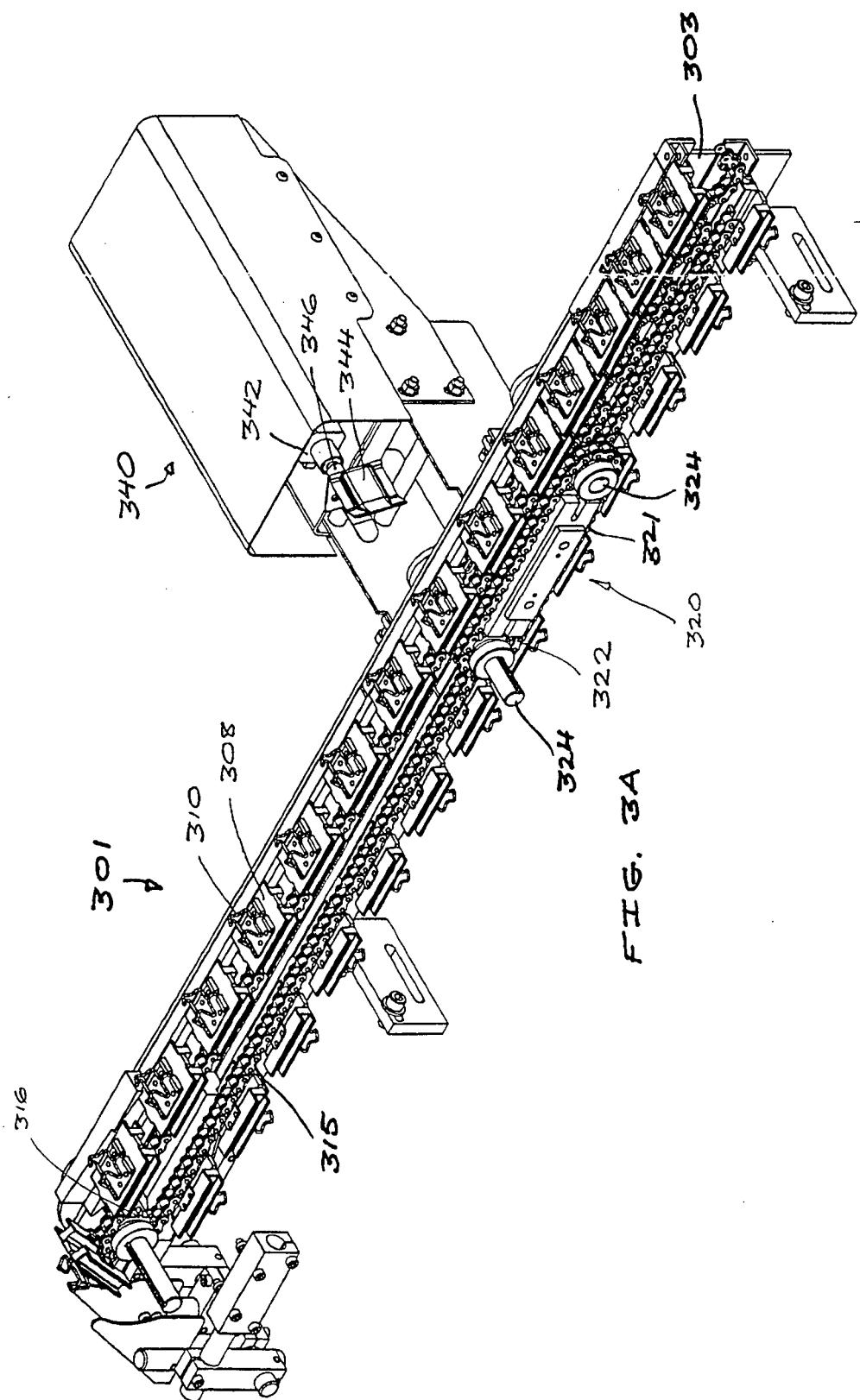


Fig.2



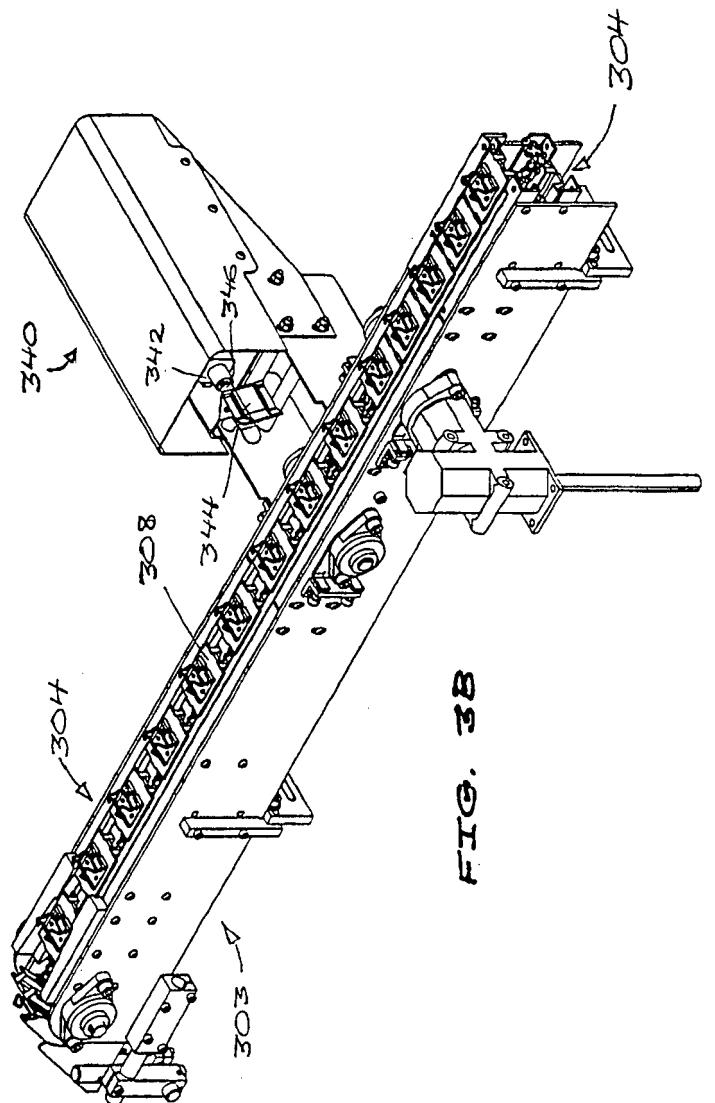


FIG. 38

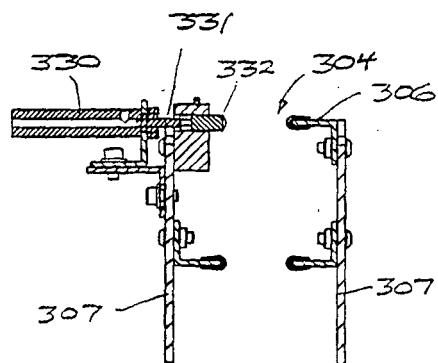


FIG. 3D

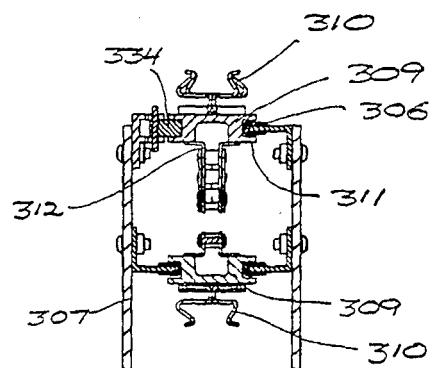


FIG. 3E

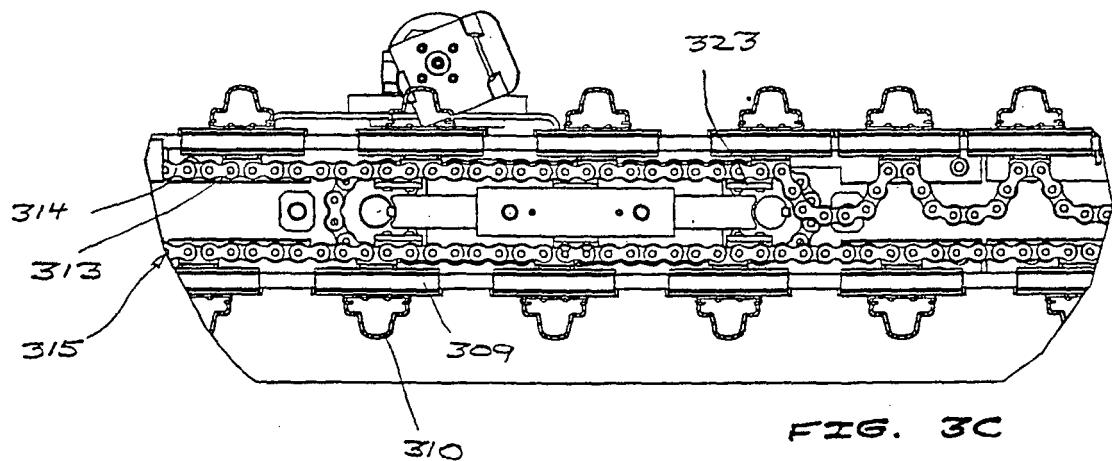


FIG. 3C

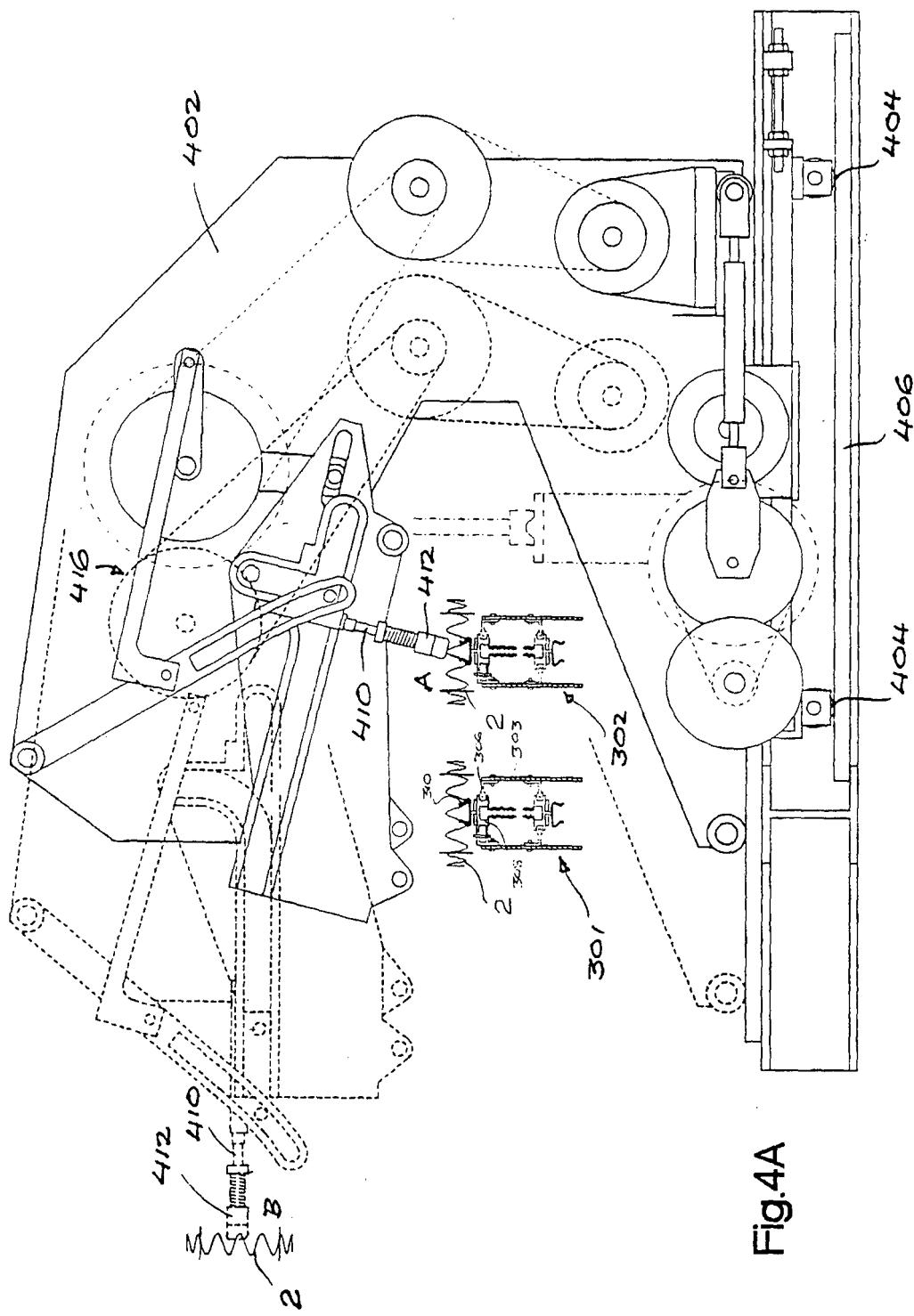


Fig.4A

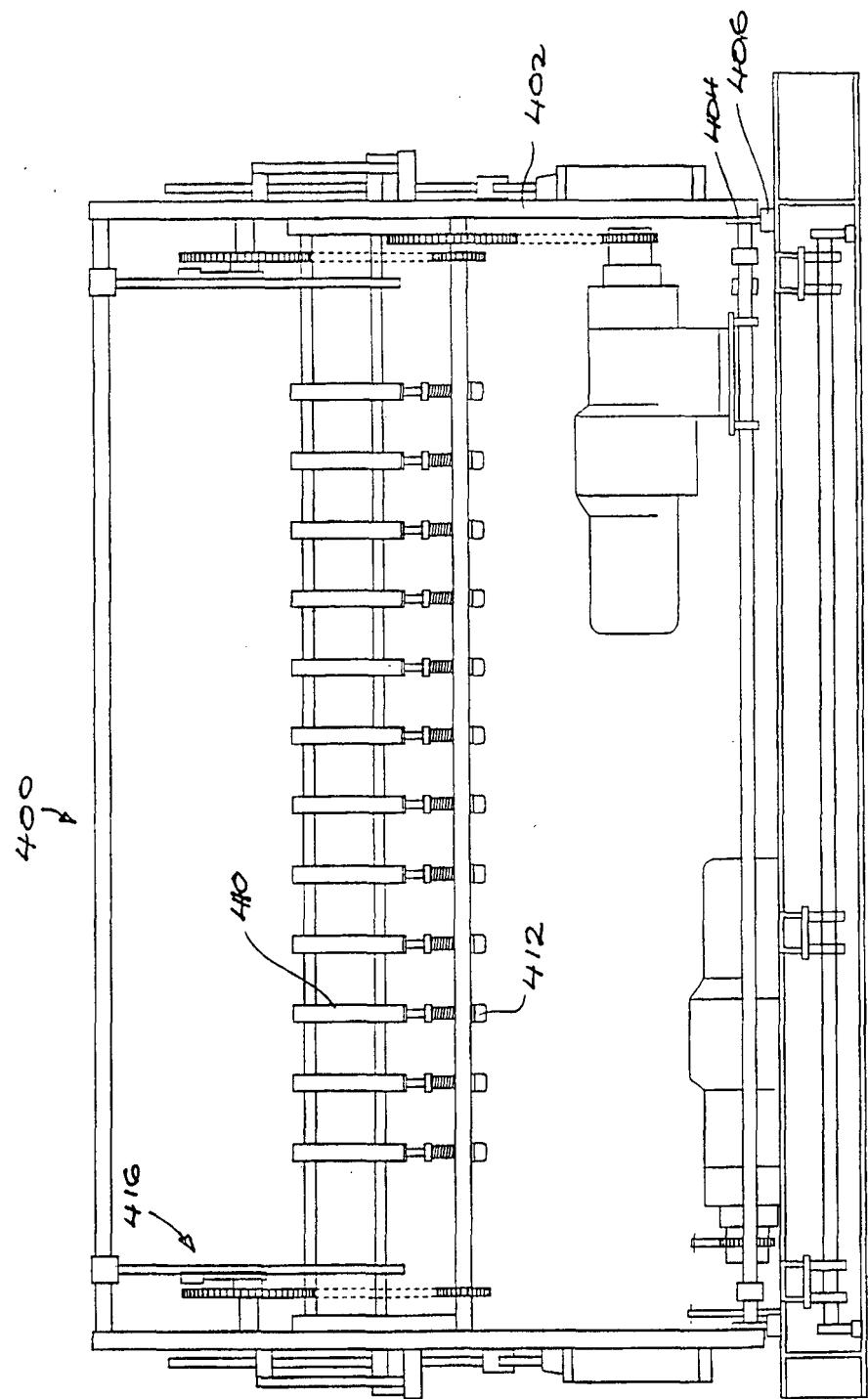


Fig.4B

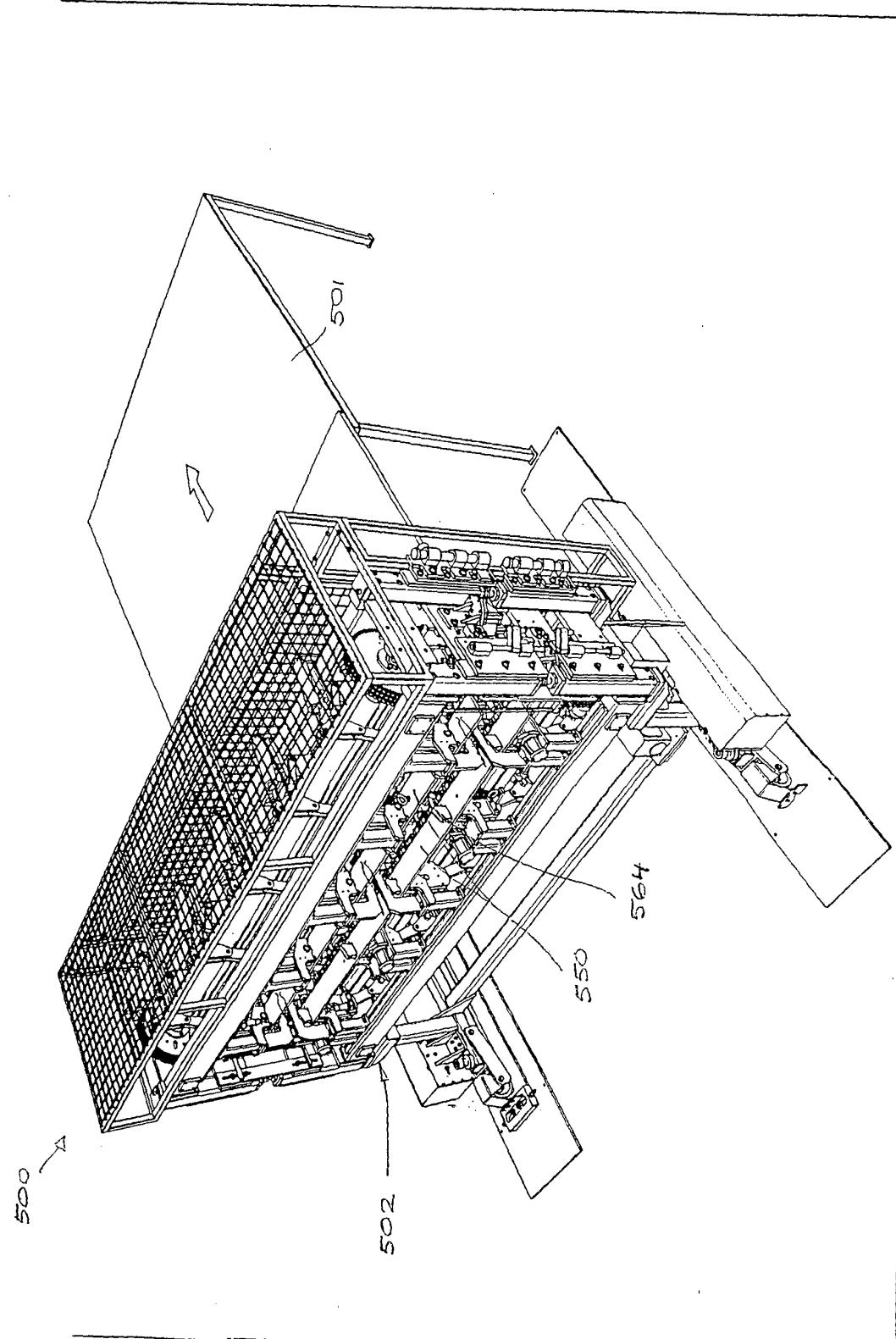
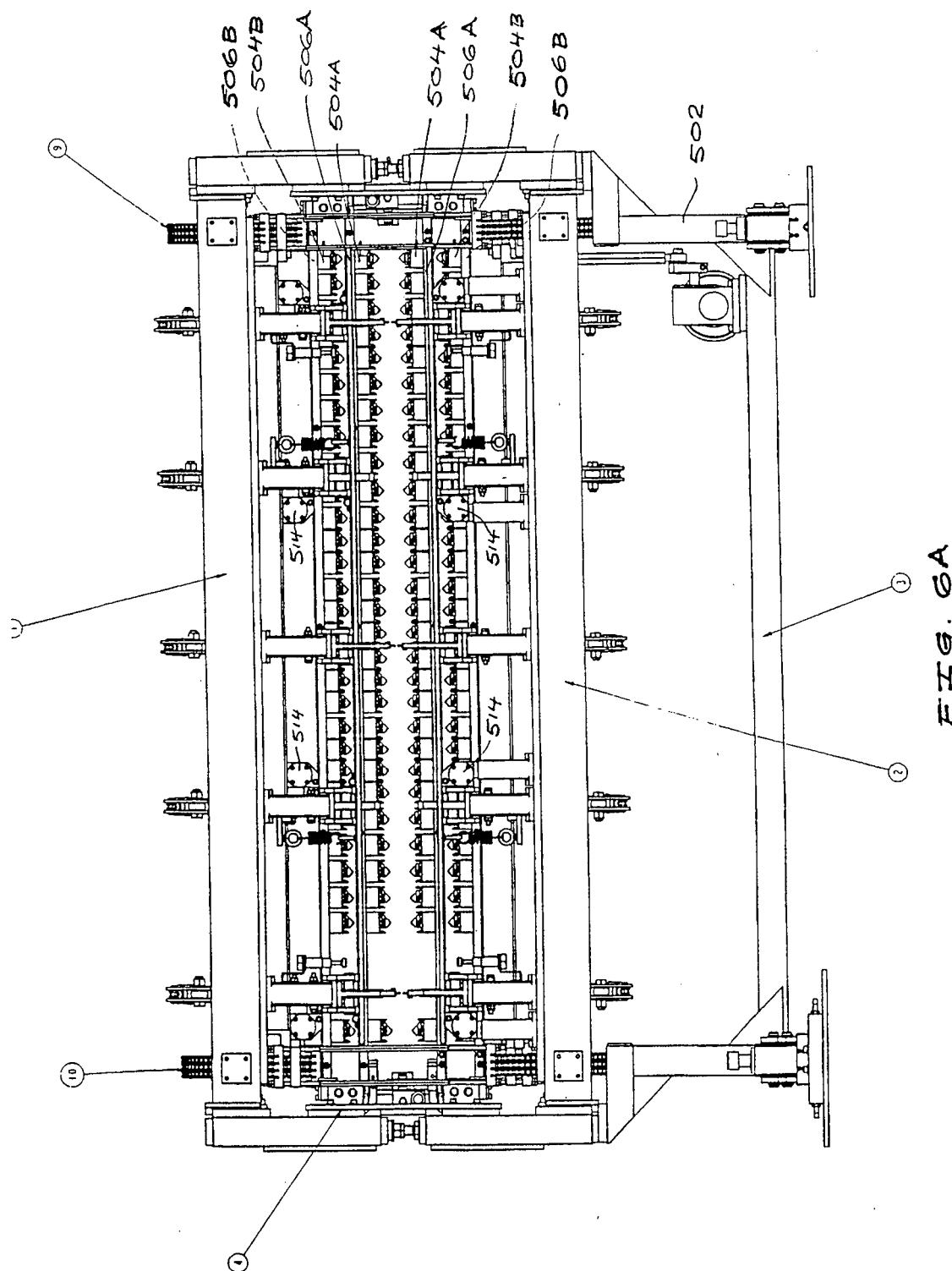


FIG. 5



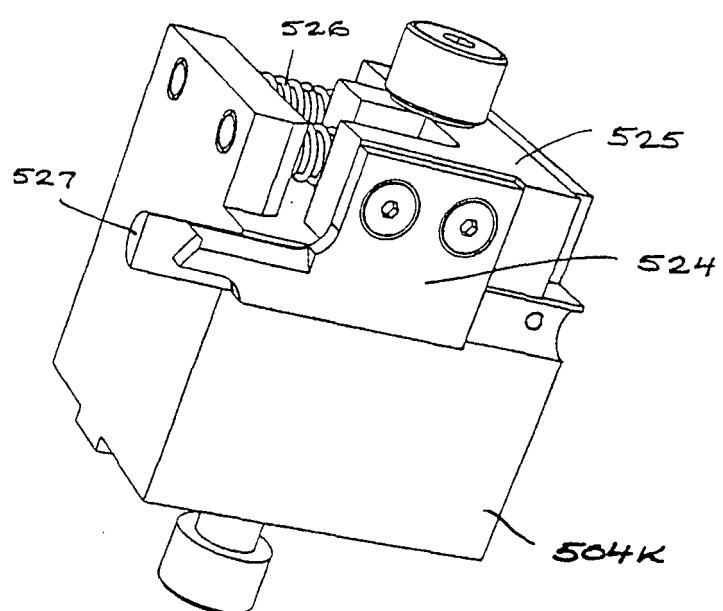
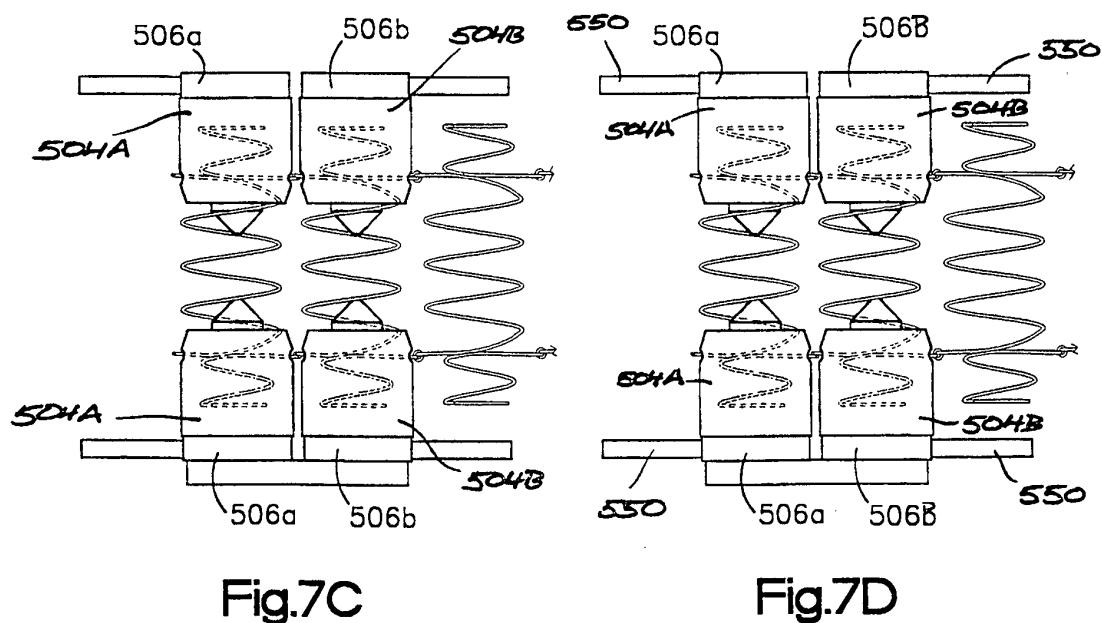
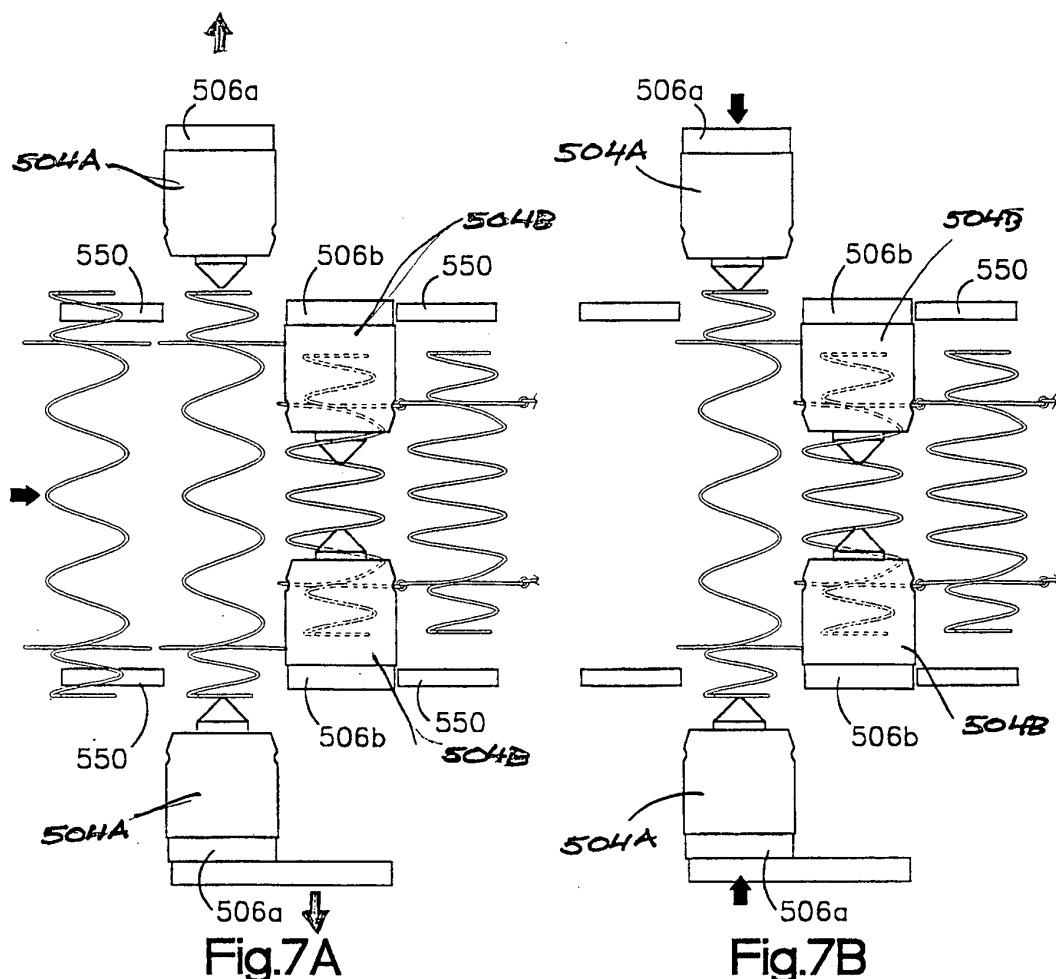


FIG. 6B



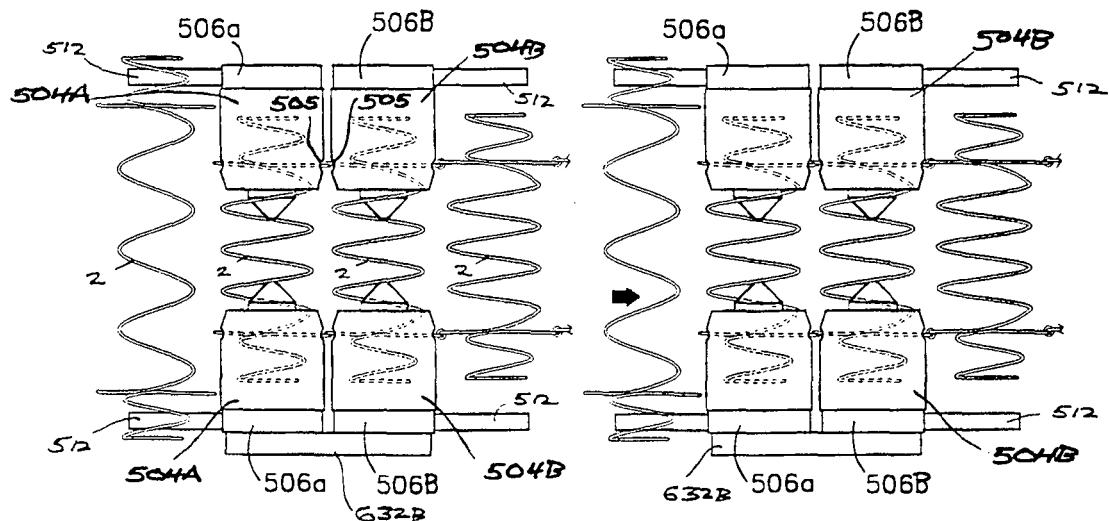


Fig.7E

Fig.7F

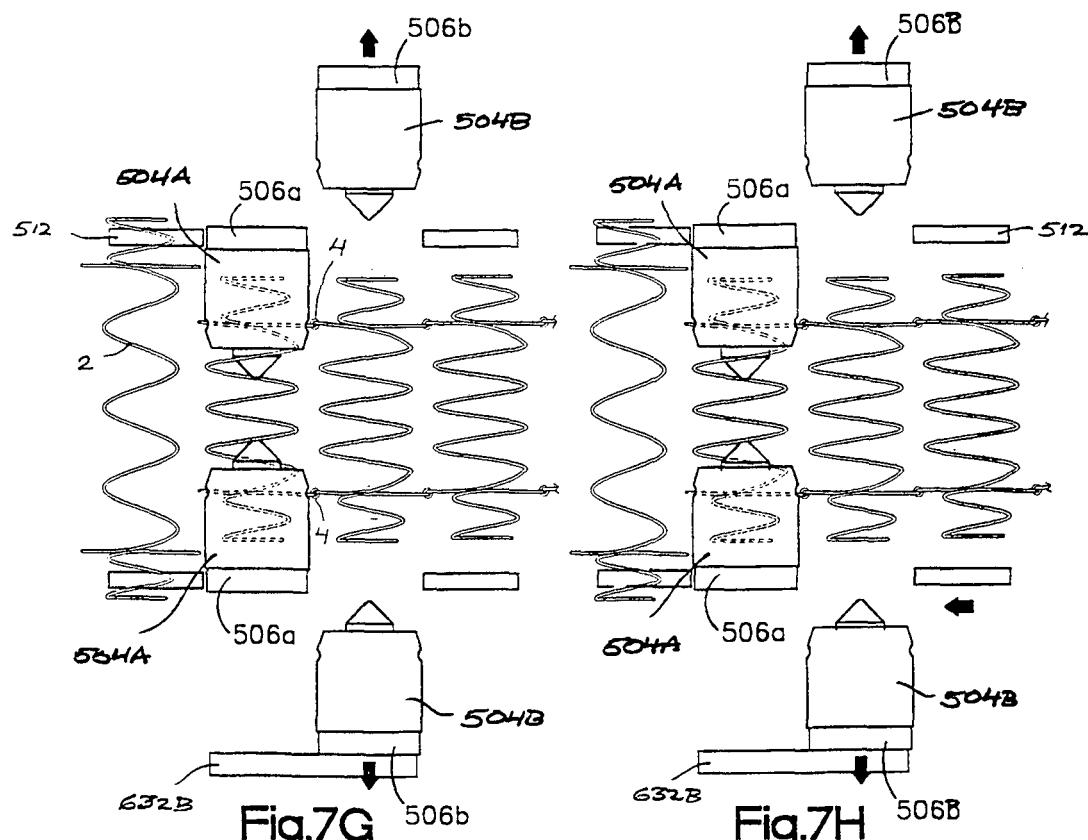


Fig.7G

Fig.7H

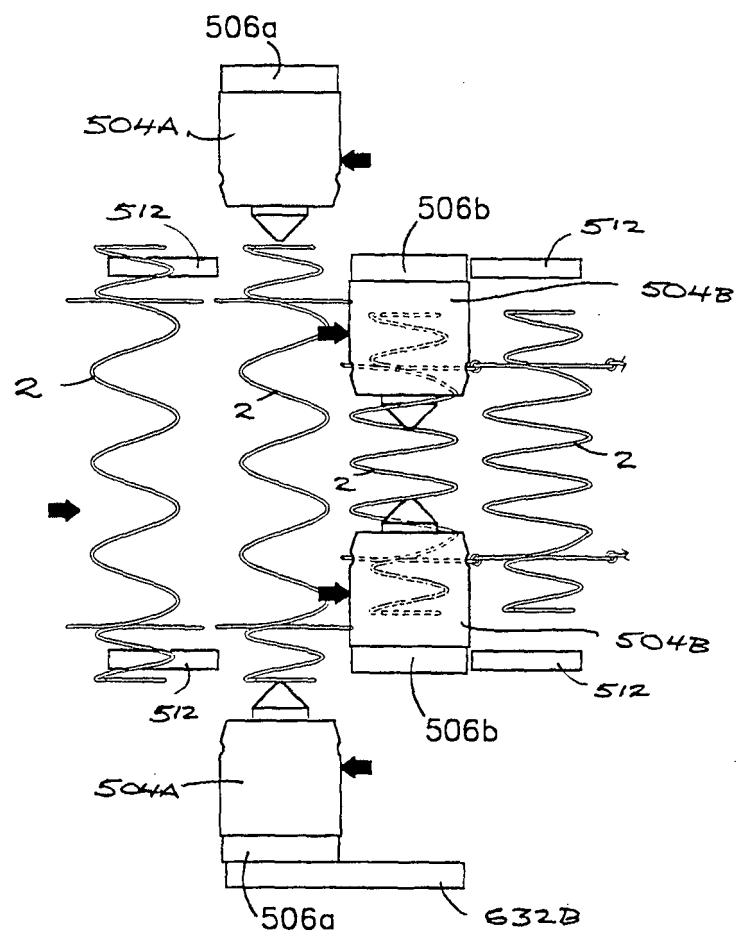


Fig.71

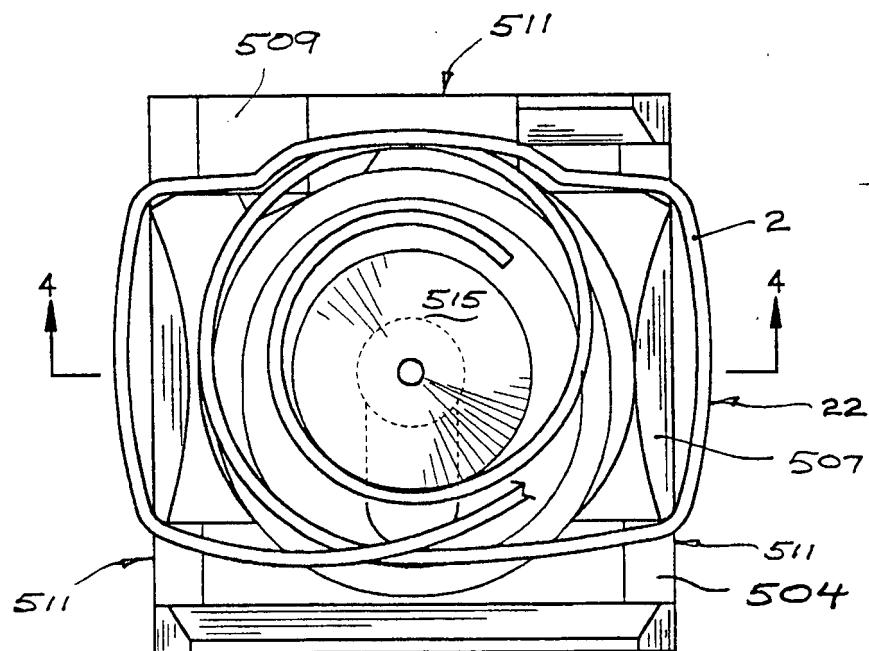


FIG. 8B

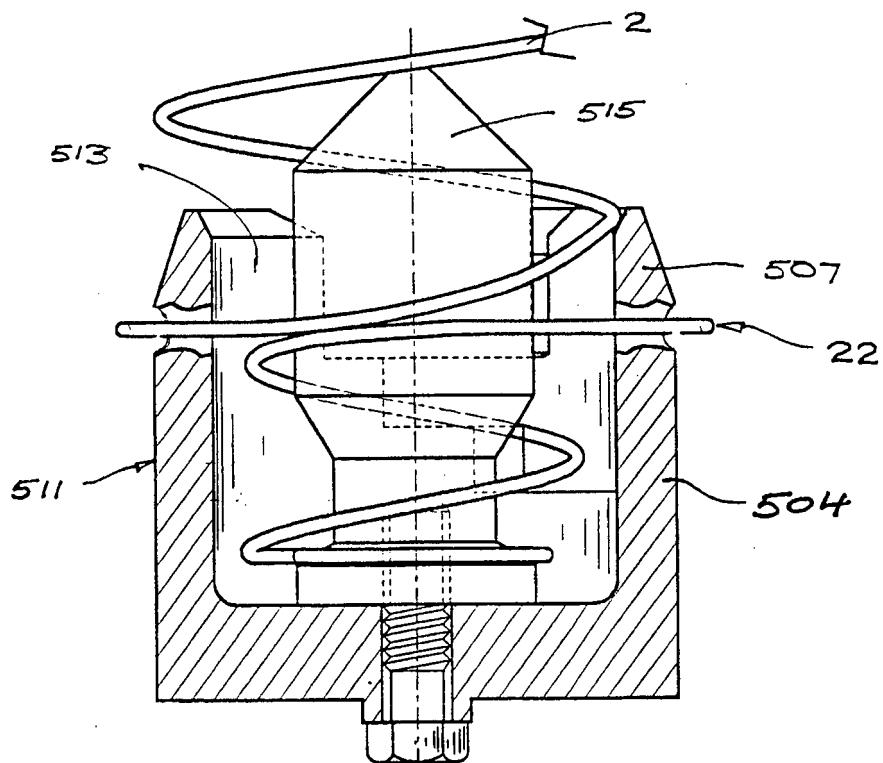


FIG. 8A

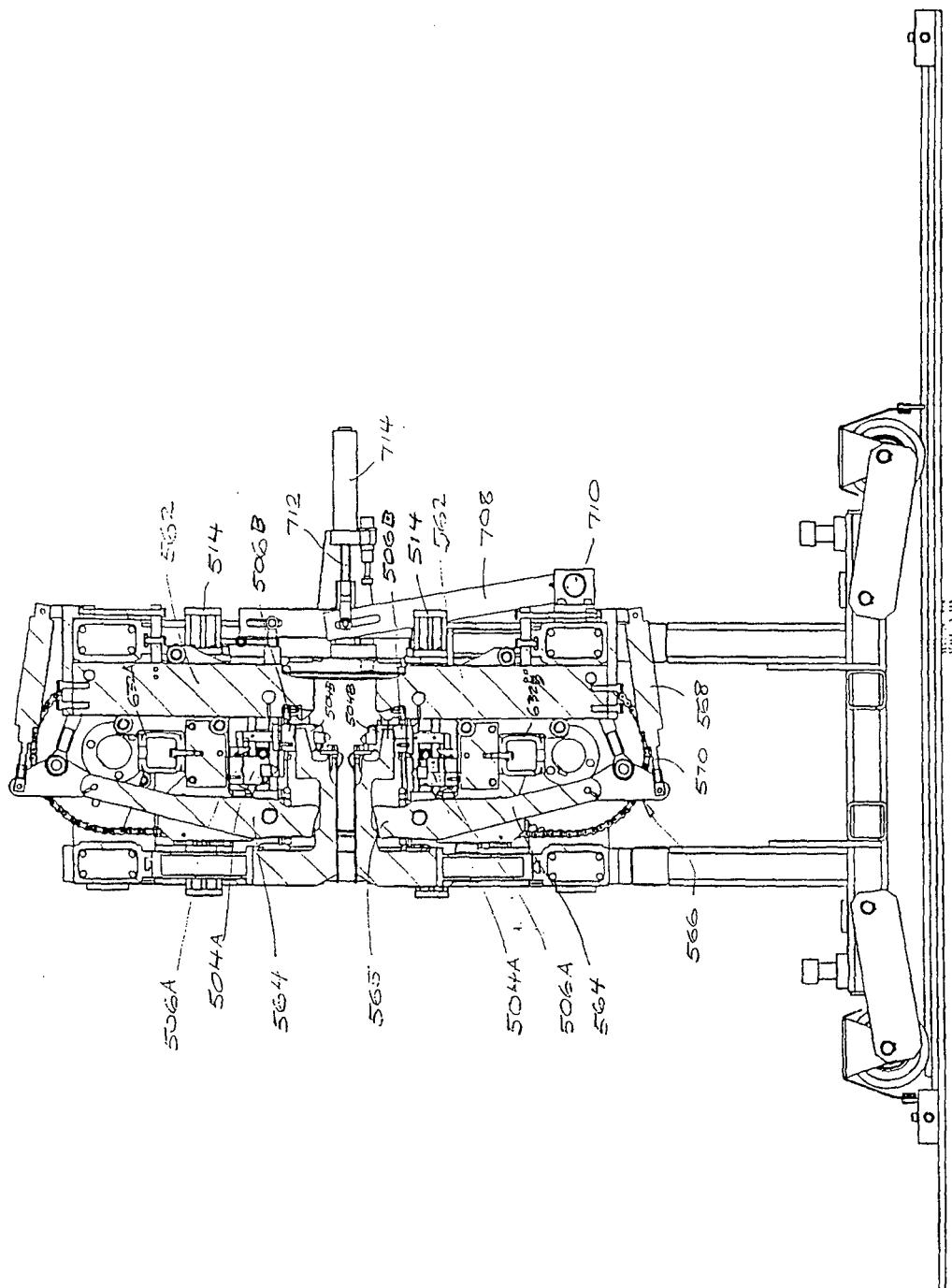


FIG. 9A

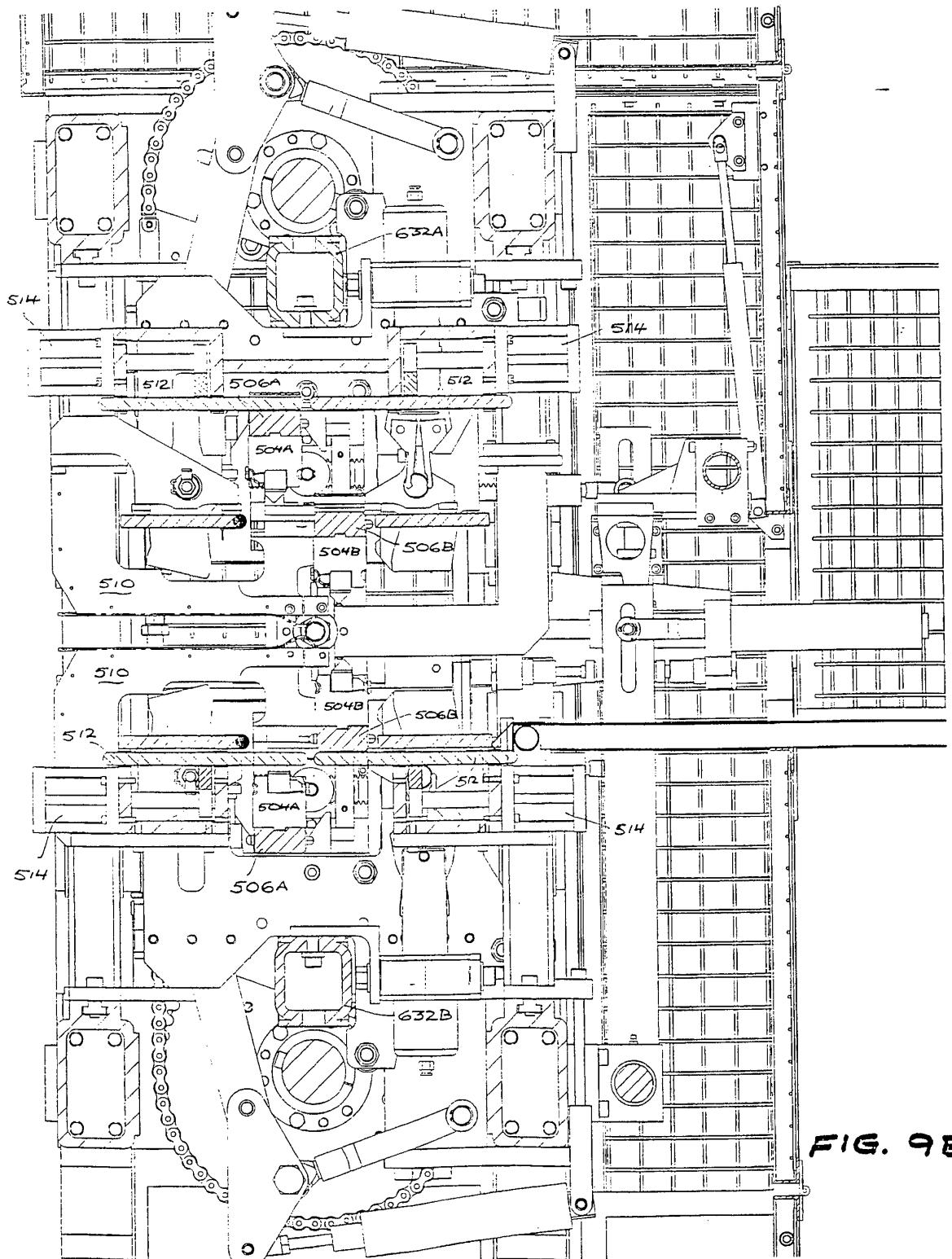


FIG. 9E

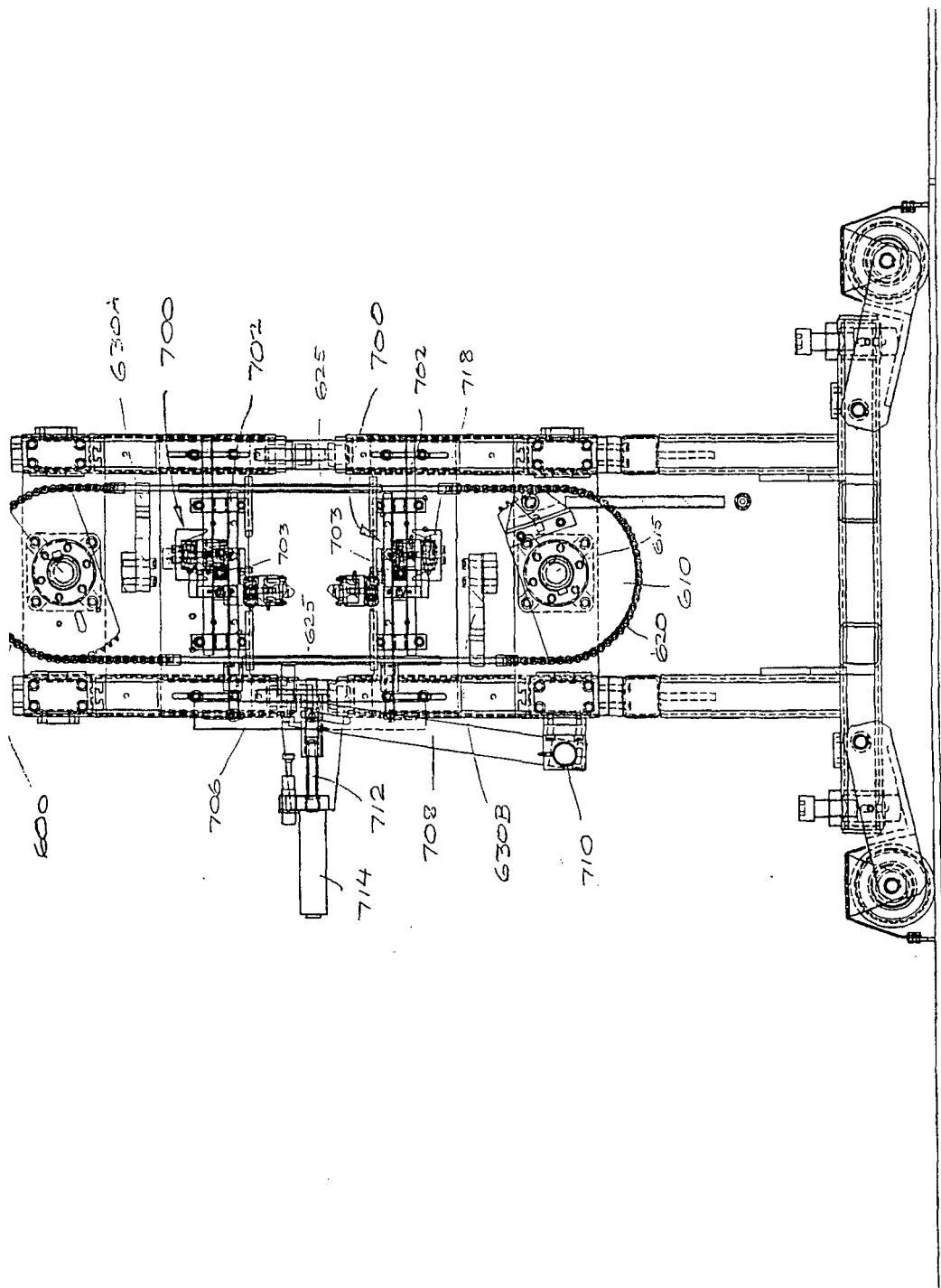
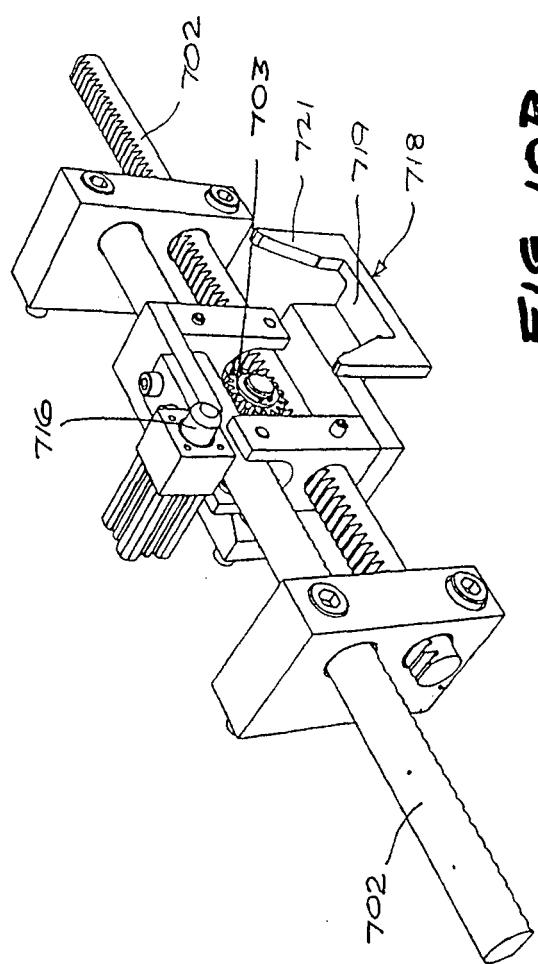


FIG. 10A

FIG. 10B



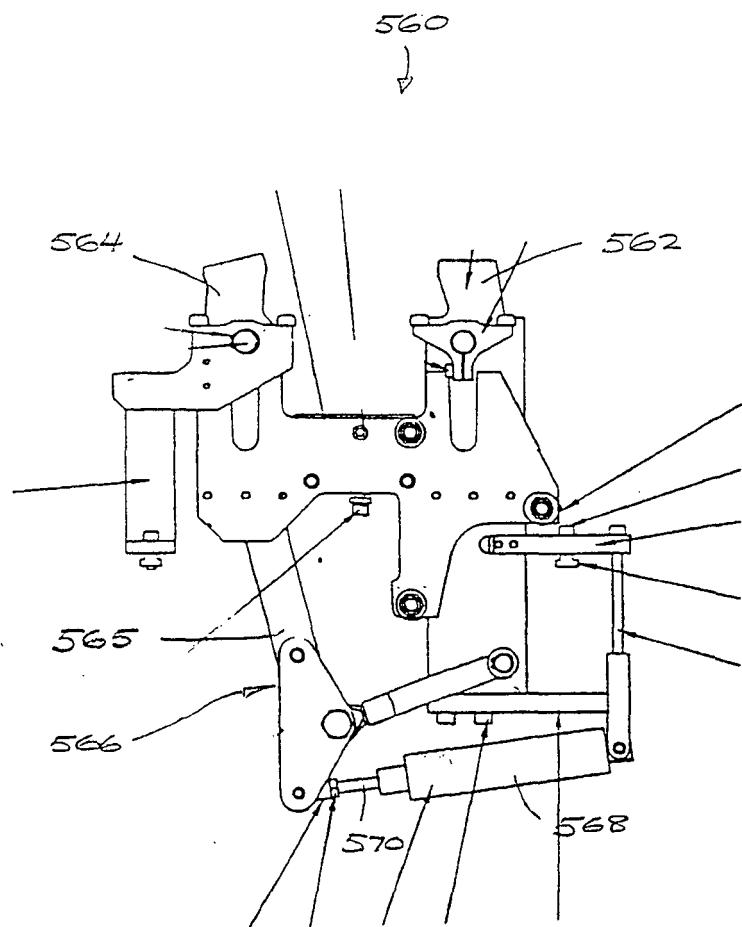


FIG. 11

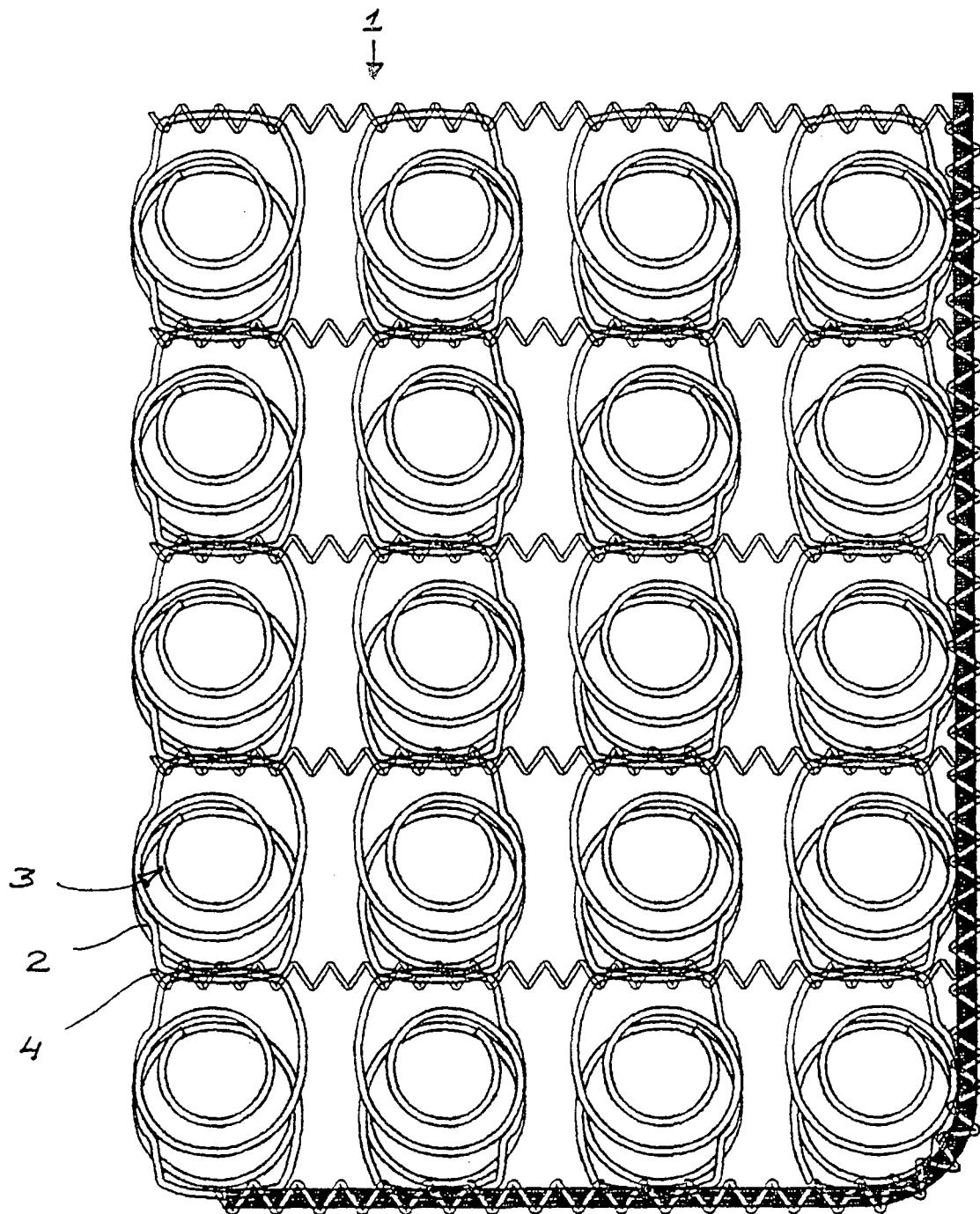


FIG. 12

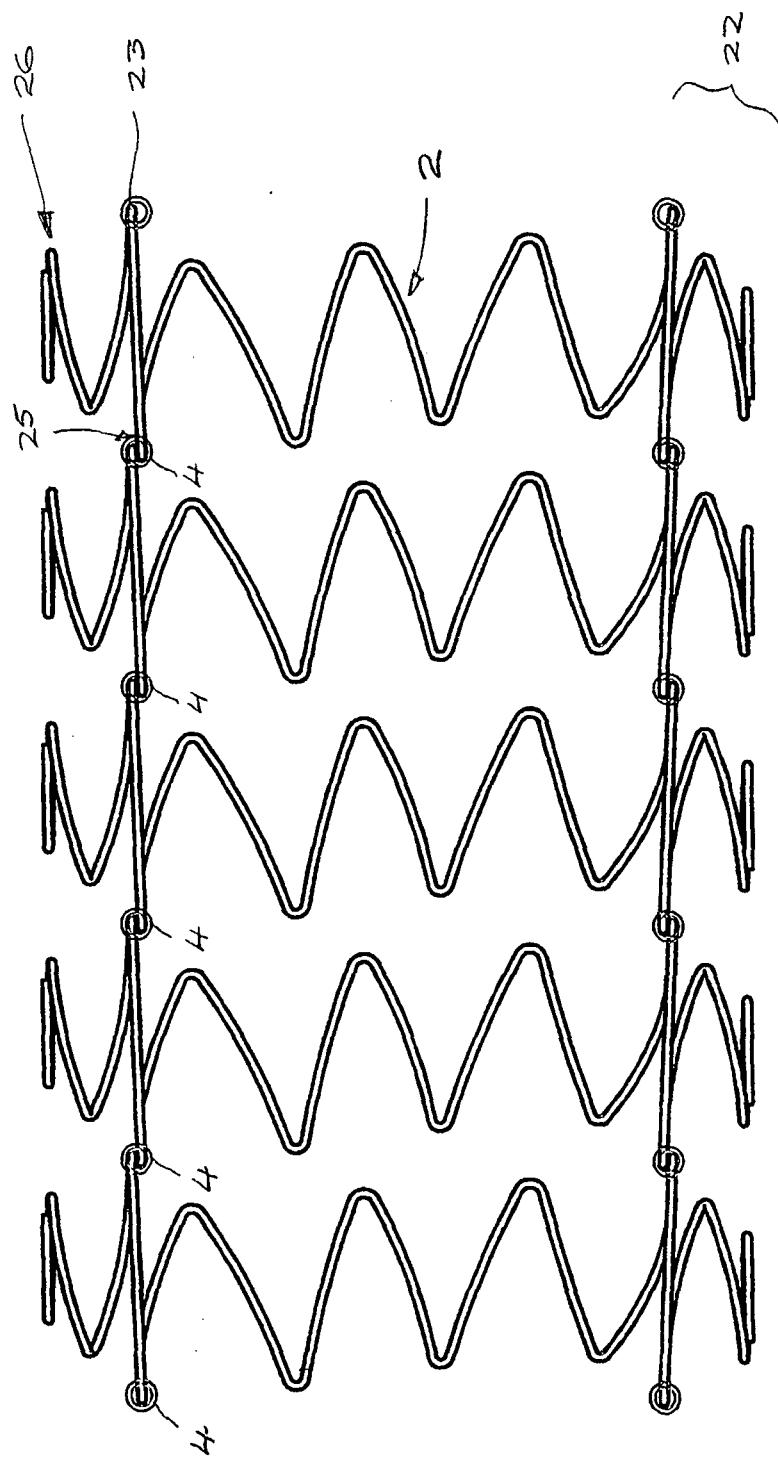


FIG. 13

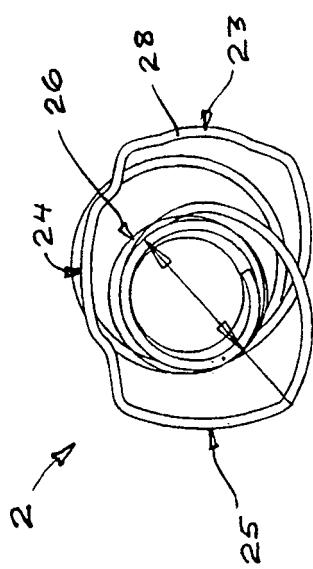
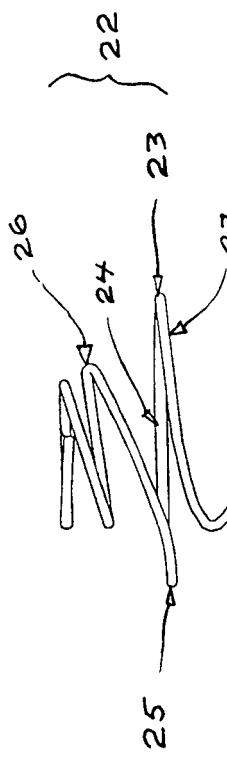


FIG. 14A

FIG. 14B



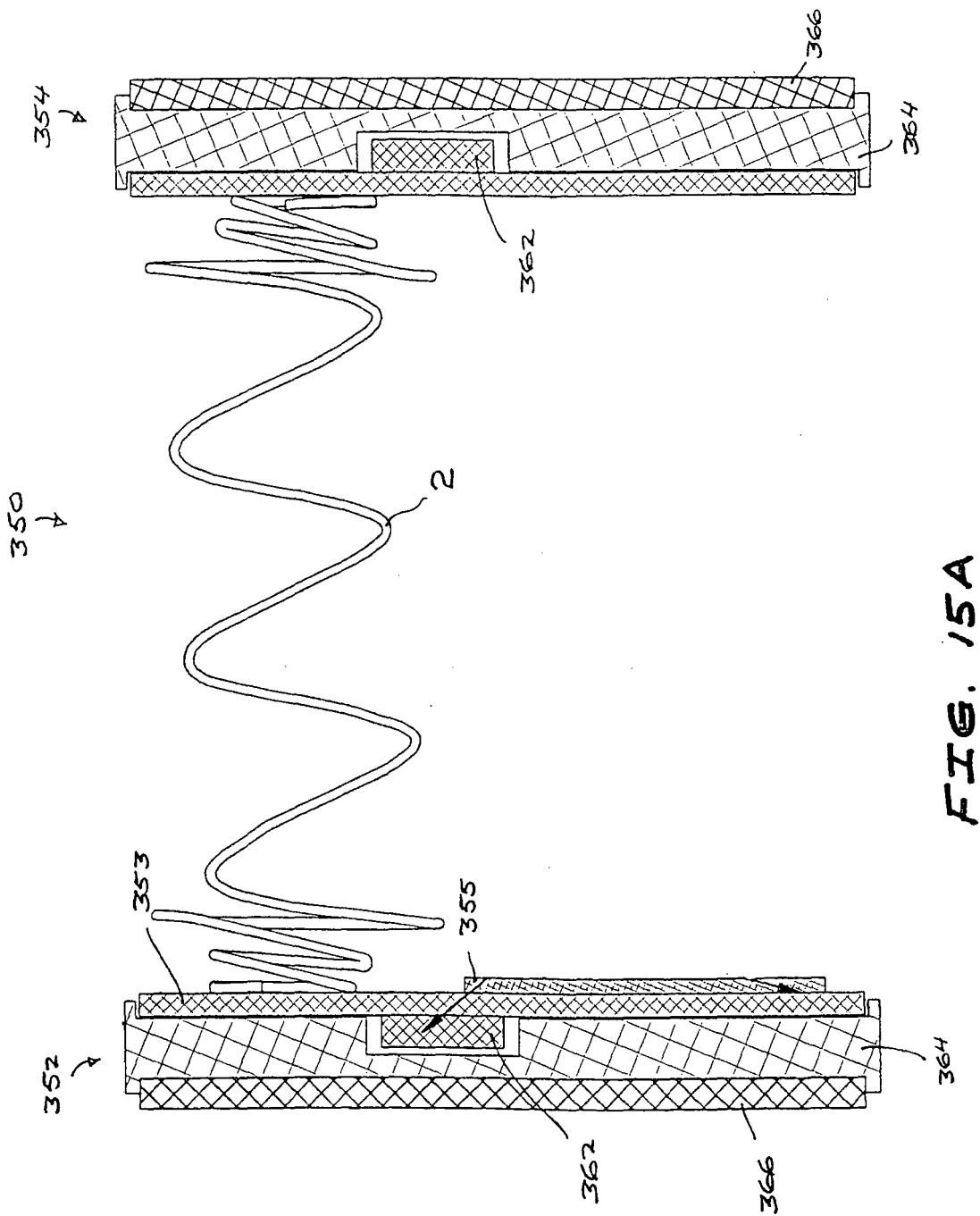


FIG. 15A

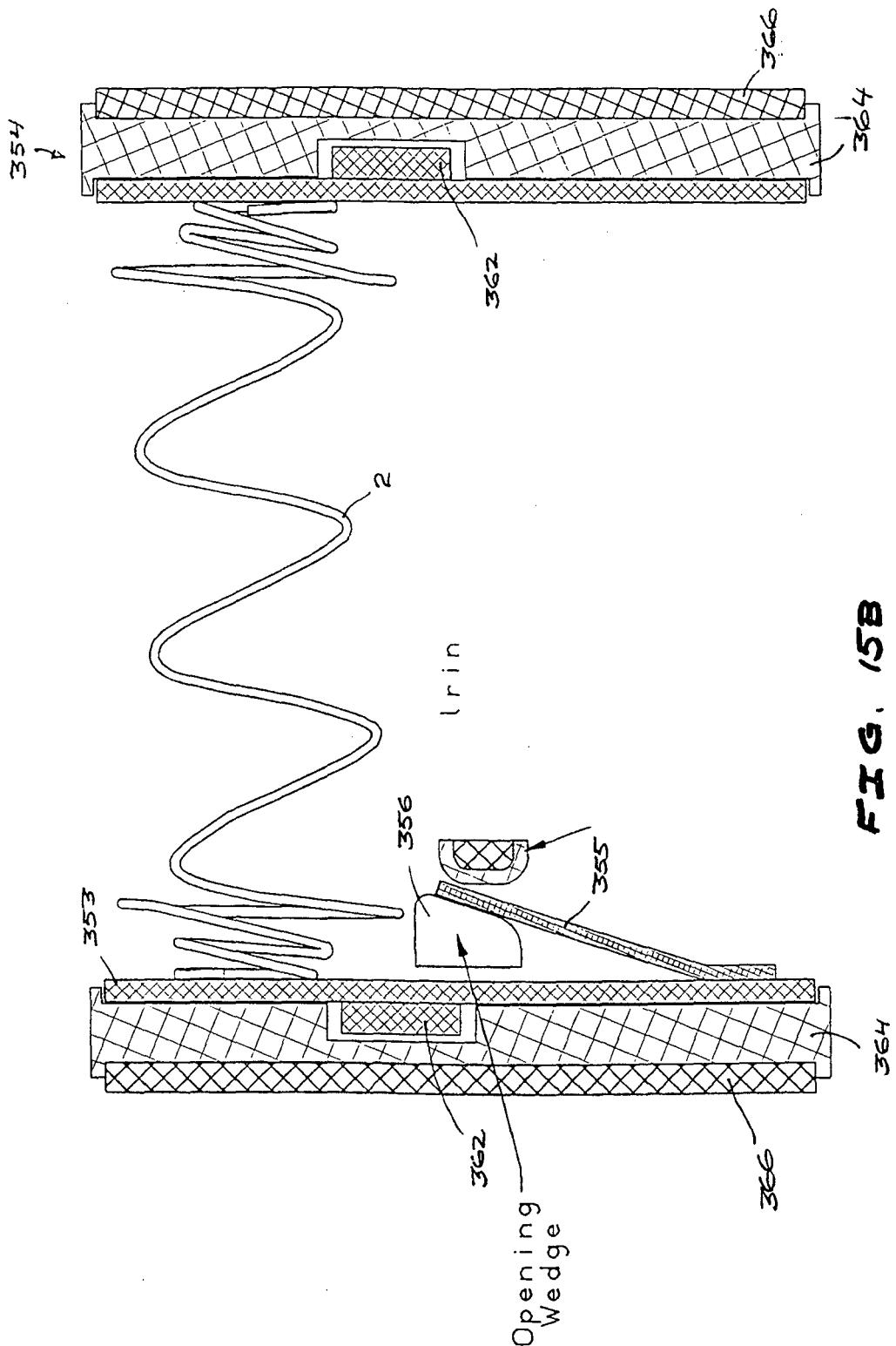
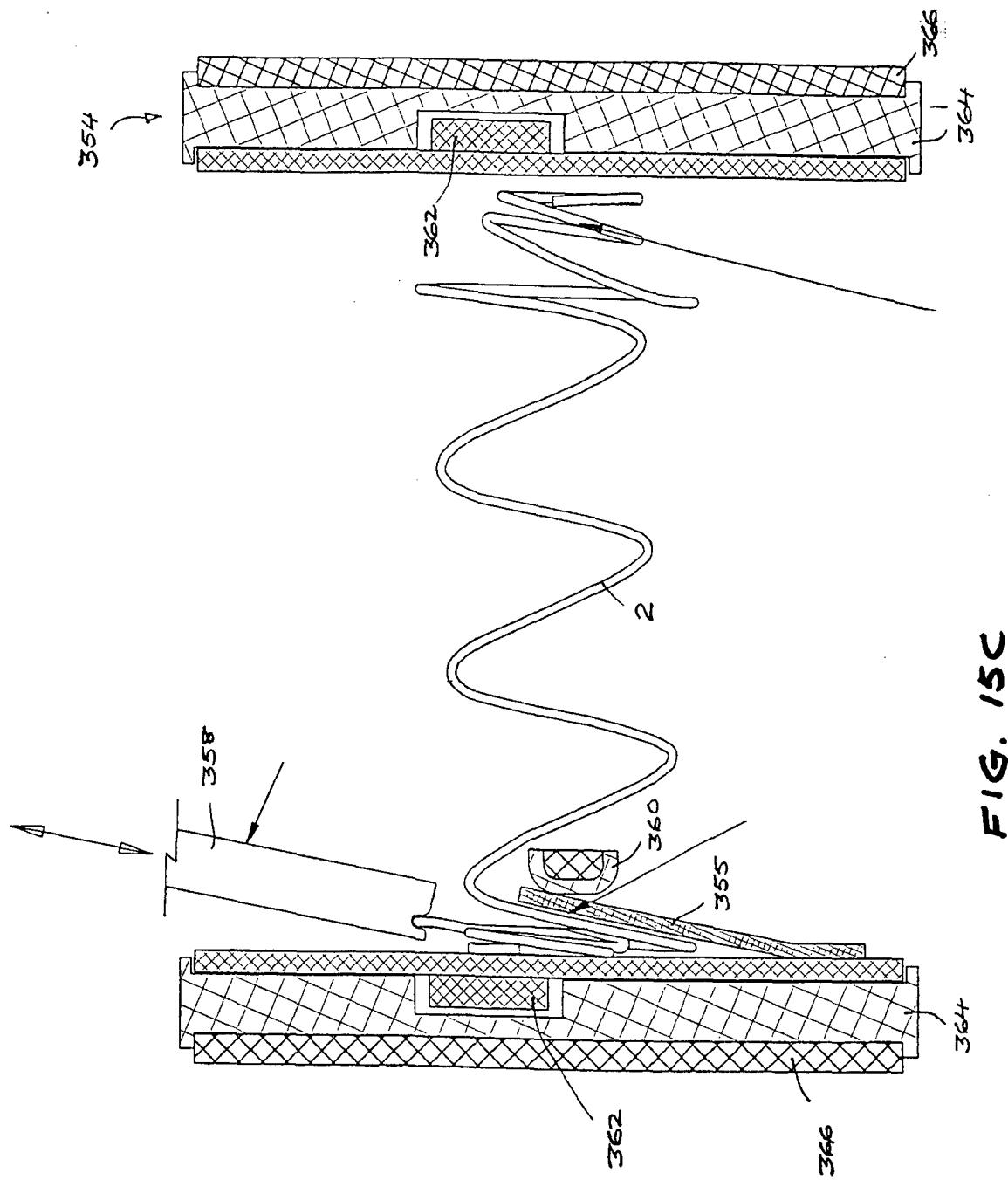


FIG. 15B



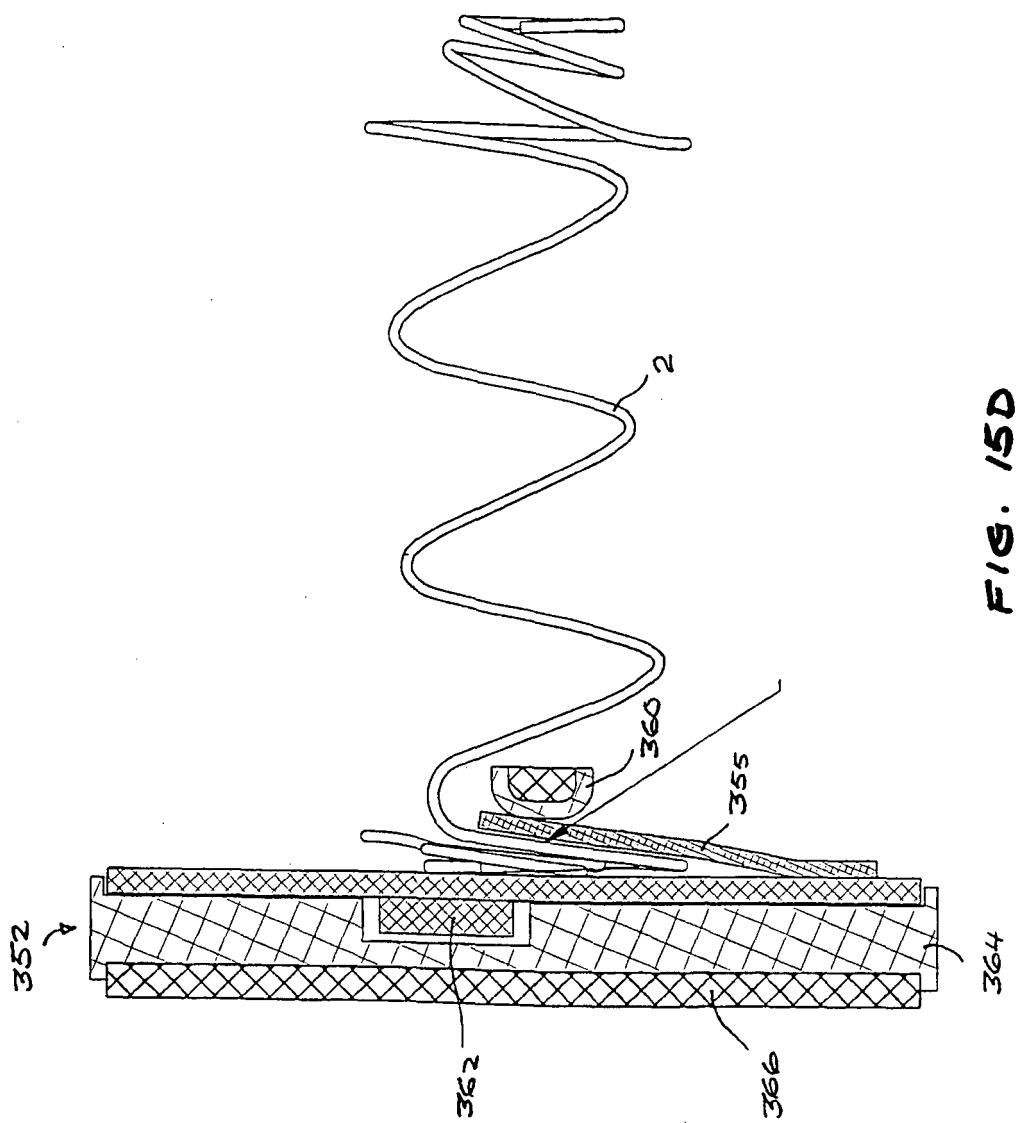
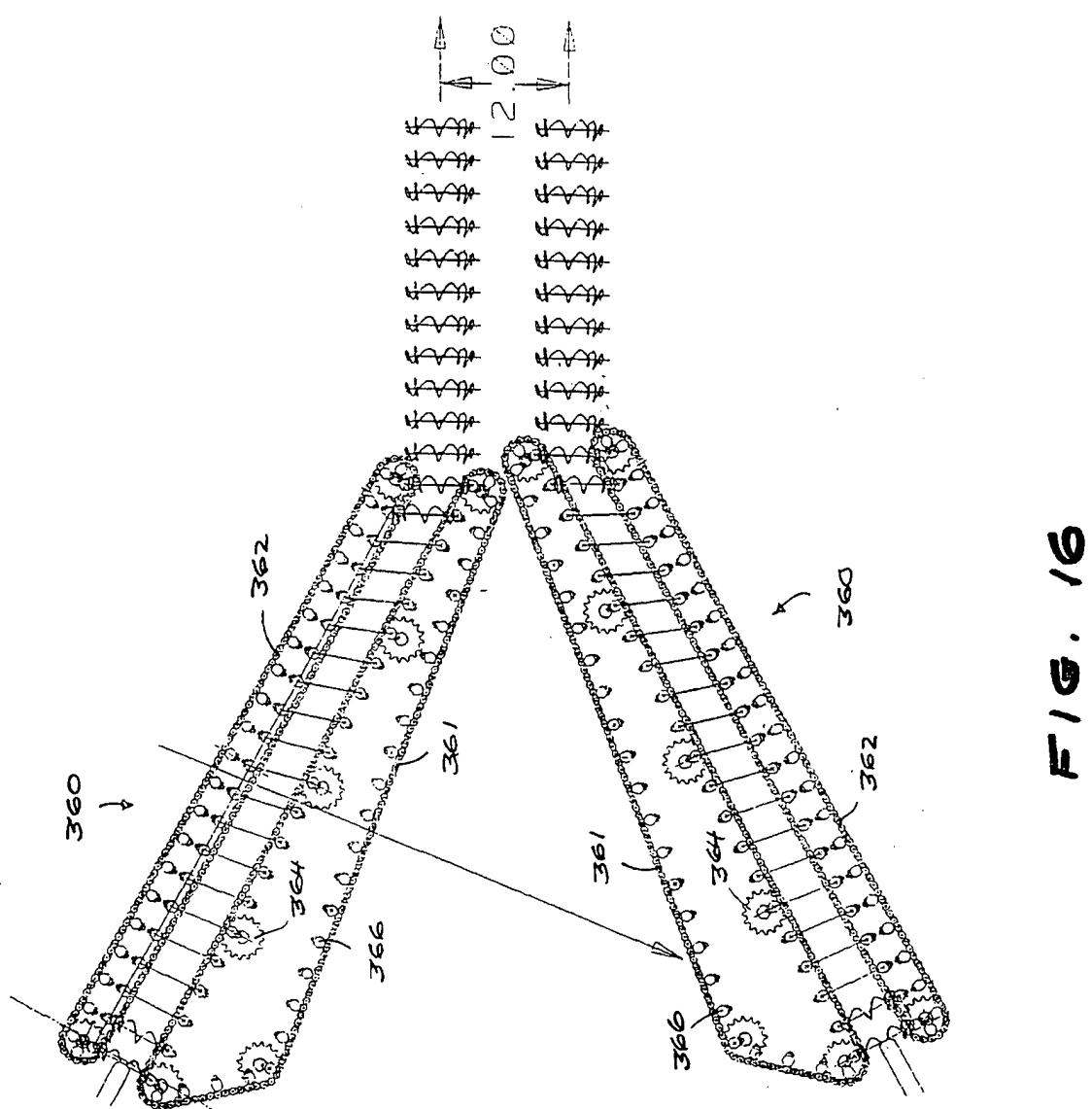


FIG. 15D



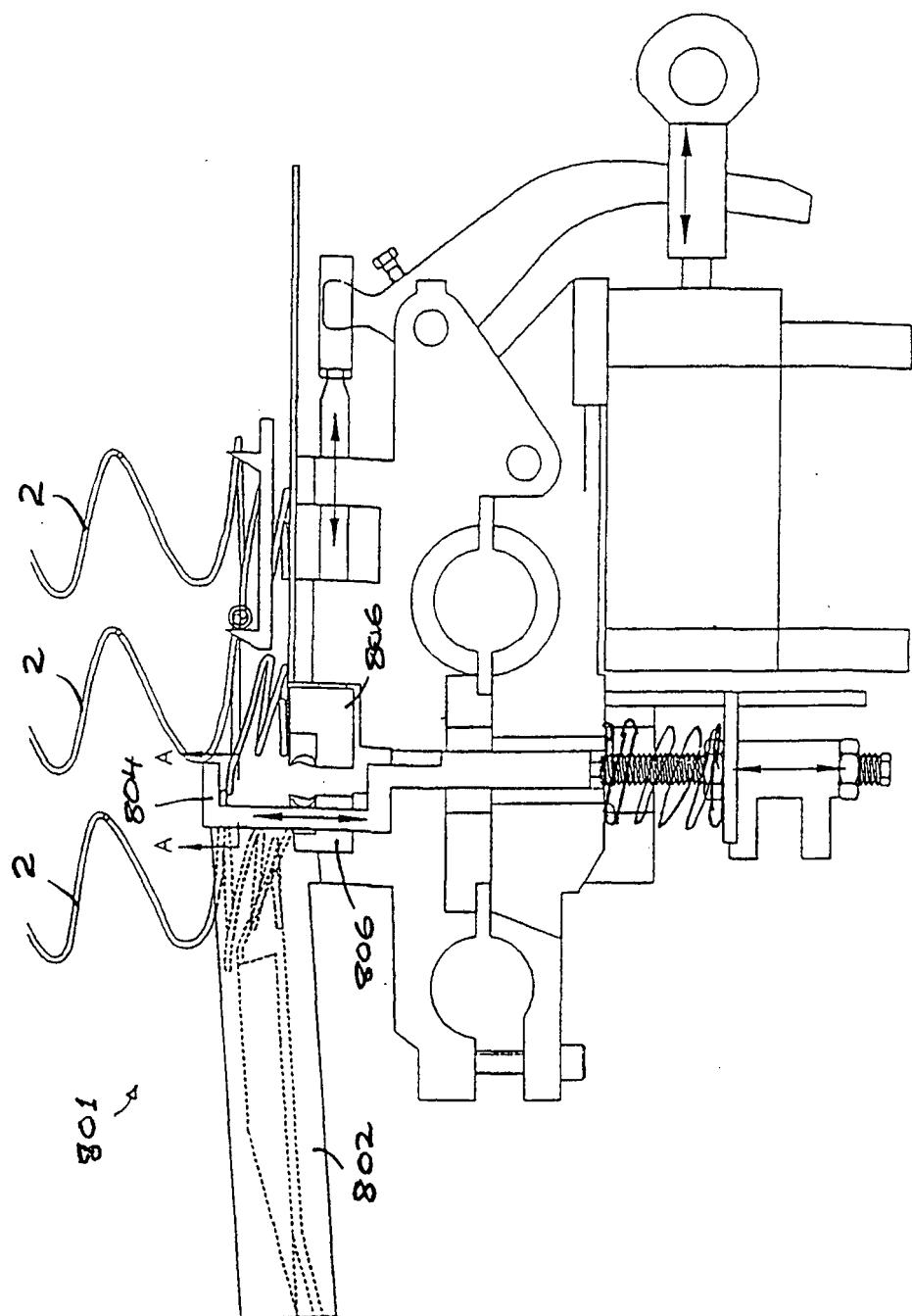


FIG. 17A

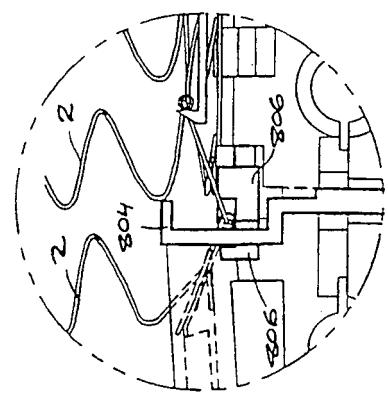


FIG. 17D

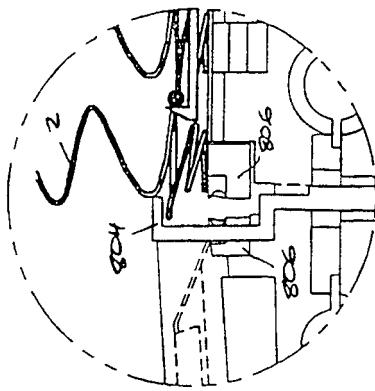


FIG. 17E

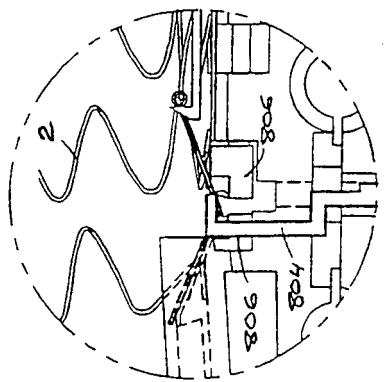


FIG. 17C

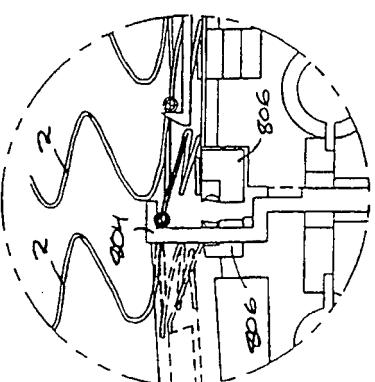


FIG. 17F

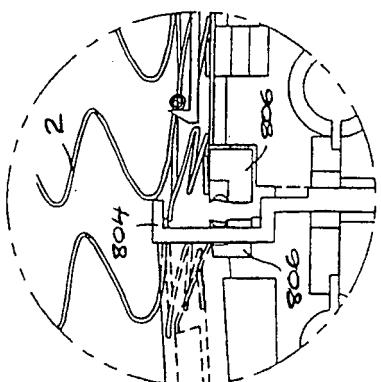


FIG. 17B

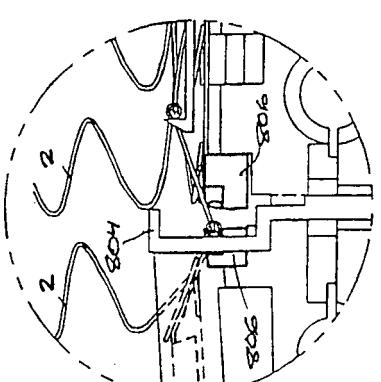


FIG. 17G

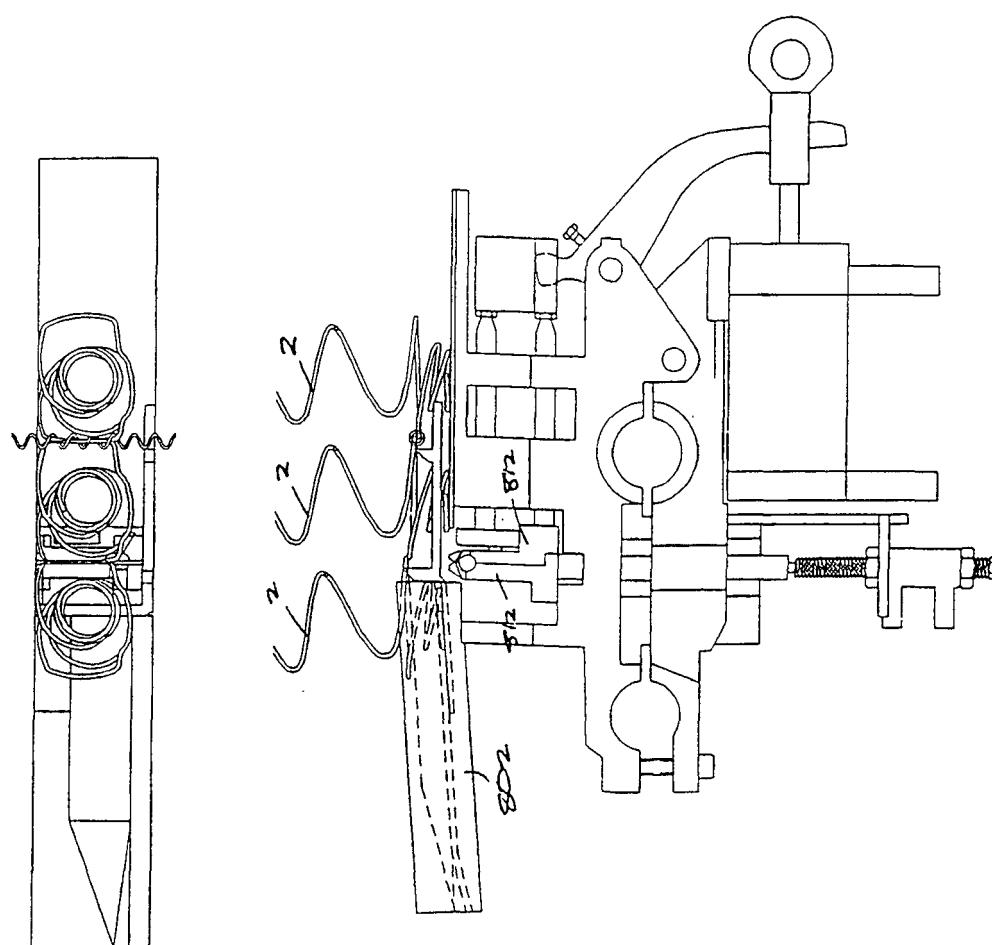
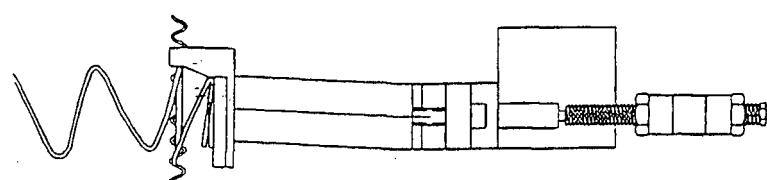
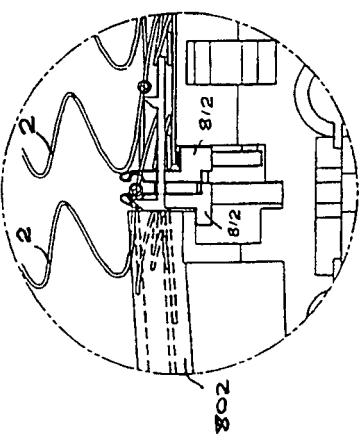
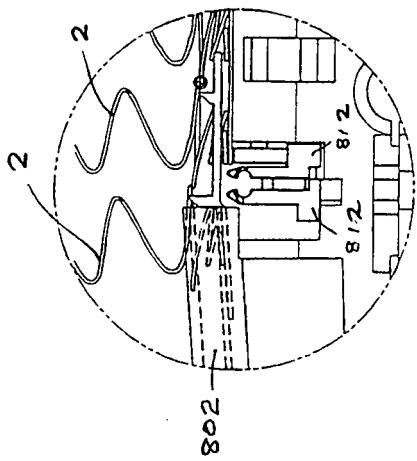
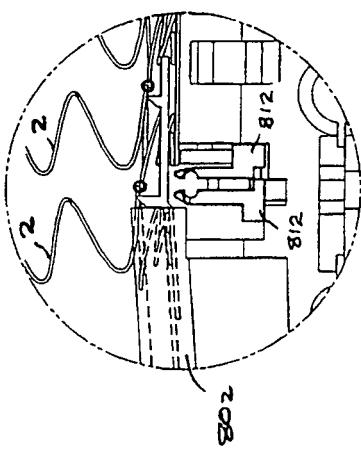
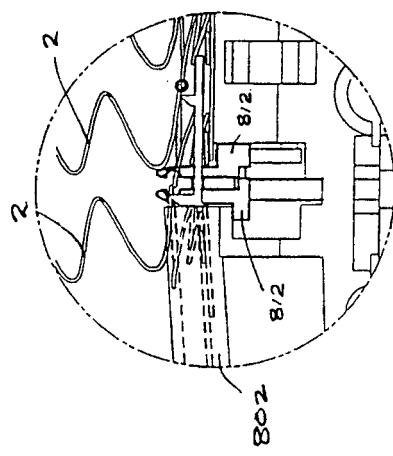
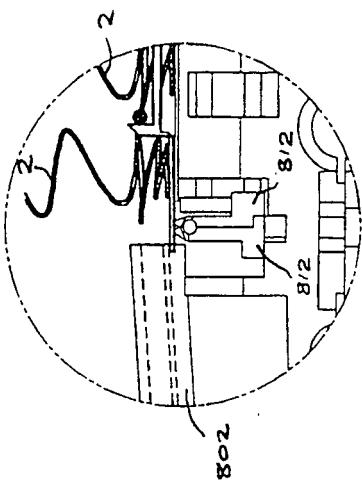
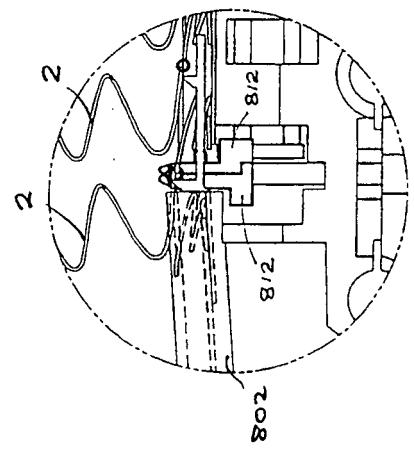


FIG. 18A





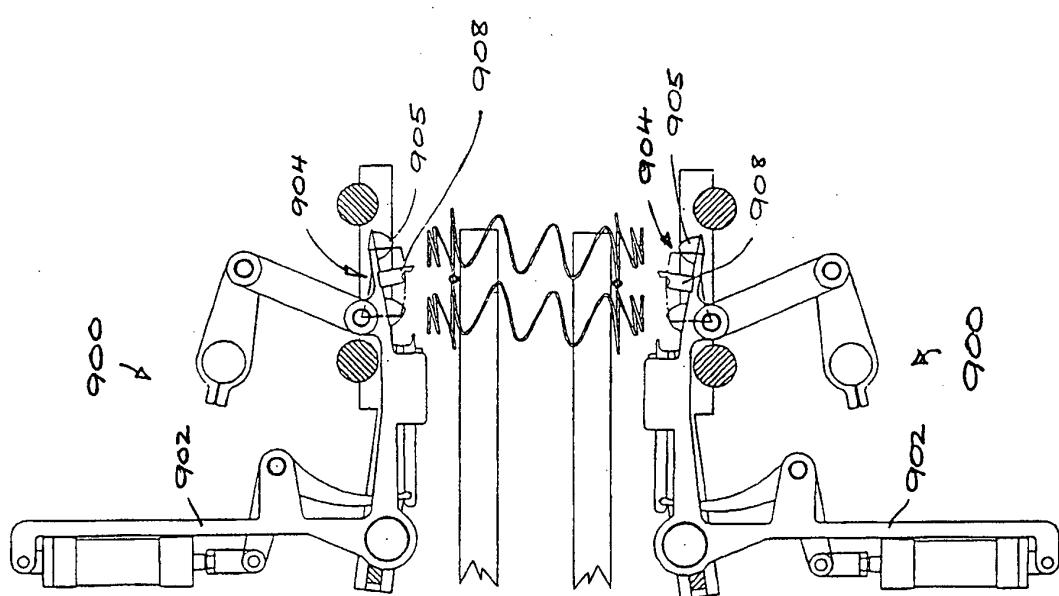


FIG. 19A

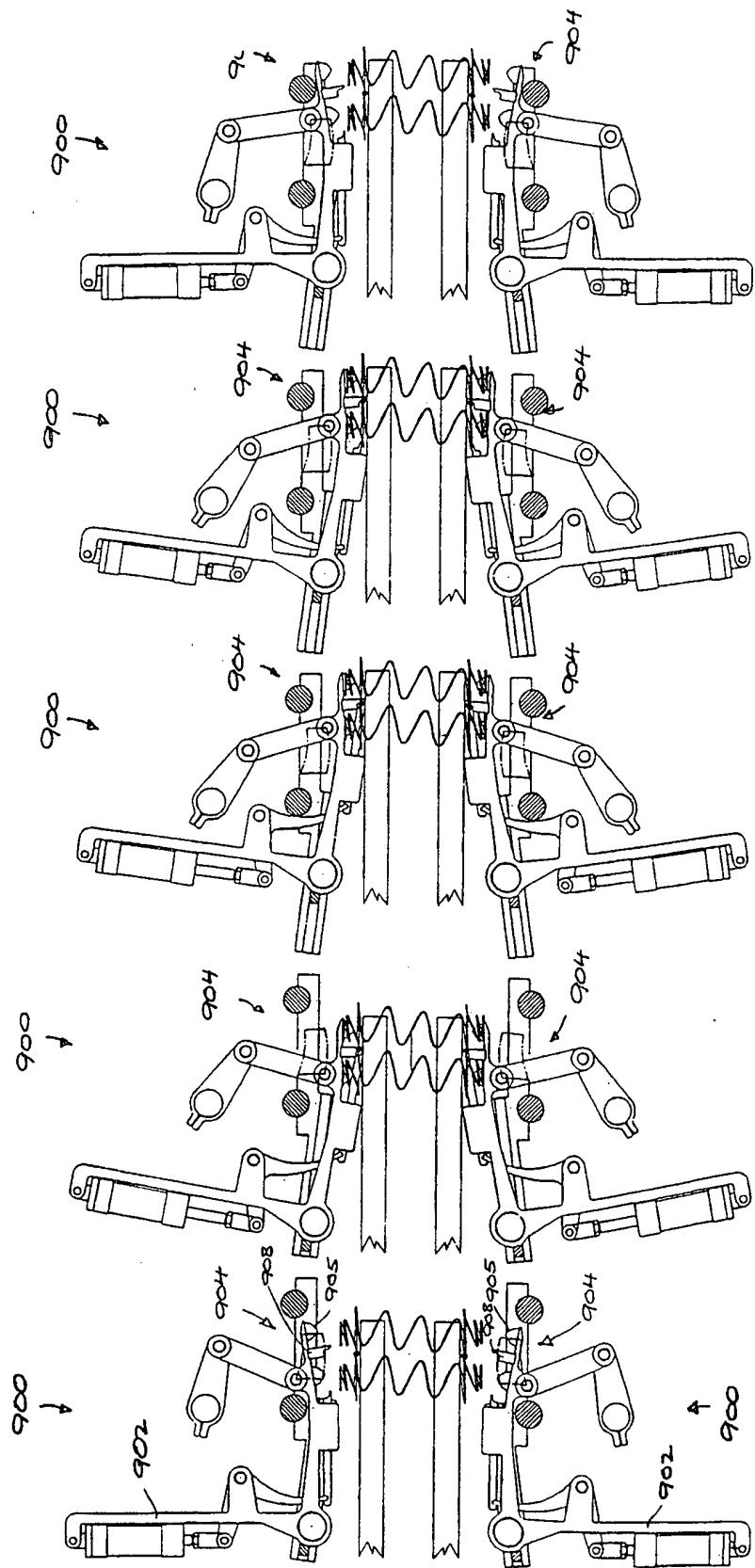


FIG. 19B

FIG. 19C

FIG. 19D

FIG. 19E

FIG. 19F

REFERENCES CITED IN THE DESCRIPTION

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- US 5013088 A [0011]